Table of contents

Continue: I01/1

SPECIAL FEATURES

These instructions describe repair work for the following pre-engaged-drive starters of type DB

- 12 V/1.8 kW	0 001 124 ...
- 12 V/2.0 kW	0 001 125 ...

This type of starter features a radial lip-type oil seal in the drive-end shield.
Older versions are fitted with an axial seal in the drive-end shield and a thrust ring at the collar of the engaging pinion and are dealt with in separate instructions.

Continue: I02/2

SPECIAL FEATURES

The following types of starter described in these instructions are equipped with a needle bearing in the drive-end shield.

- 12 V/2.0 kW	0 001 125 016
- 12 V/2.0 kW	0 001 125 017
- 12 V/2.0 kW	0 001 125 018
- 12 V/2.0 kW	0 001 125 019

Continue: I03/1

SPECIAL FEATURES

A new parts set is always to be used on assembly.

Lubricate in line with lubrication schedule before and during assembly.

Prior to assembly, use three-square scraper to remove all residual paint from fitting and sealing surfaces.

Continue: I03/2

SPECIAL FEATURES

If the starting motor is painted after assembly, make sure that paint does not ingress into the interior of the starting motor through the vent holes.
Seal vent holes before painting.

Always re-open vent holes after painting to ensure proper operation of starting motor.

Continue: I04/1

SPECIAL FEATURES

The overrunning-clutch drive is subject to considerable wear and is always to be replaced.

The bushings in the drive-end bearing and commutator end shield are always to be renewed.

The entire planetary gear train is to be replaced in the event of damage to or impermissible wear on the output shaft of the planetary gear train.

Continue: I04/2

SPECIAL FEATURES

Some starting motors of type DB (e.g. 0 001 125 5..) are provided with a busbar with thermoplastic sheathing; in such cases use is made of terminal 30 for connection.

The busbar is attached to terminal 30 and the drive-end bearing.

Continue: I05/1

SPECIAL FEATURES

There is no means of checking the solenoid switch which would provide reliable information on long-term trouble-free operation.

It is therefore advisable to renew the solenoid switch when repairing the starting motor.

On installation, approx. 0.5 g of Loctite 577 (5 994 090 000) is to be applied to the threads of the solenoid switch bolts.

Continue: I01/1

STRUCTURE, USAGE

PC user prompting:
Position cursor on button and confirm.
Microcard user prompting:
User prompting is provided on every page e.g.:
- Continue: I 17/1
- Continue: II 18/1 Fig.: II 17/2

Brief instructions may include several rows of coordinates.
I../. = first coordinate row
II../. = second coordinate row
III../. = third coordinate row
etc.

.../1 = upper coordinate half
.../2 = lower coordinate half

Continue: I01/1

GENERAL

Unless otherwise stated, the voltages indicated in these instructions are DC voltages.
AC voltages are marked by the symbol " * ".

Continue: I07/2

GENERAL

Expert repairs are only possible using the prescribed tools and measuring instruments, which are in perfect working order. We therefore recommend that exclusive use be made of the tools listed.

The use of incorrect and unsuitable tools and testers can lead to injury and may damage the product concerned or its component parts.

Continue: I08/1

GENERAL

Some of the tools listed in these repair instructions were originally developed for a different application.

The appropriate instructions are to be heeded when using these tools.

Continue: I08/2

GENERAL

Only use replacement parts given in the service parts list for the starting motor concerned.

Proper functioning presupposes use of the lubricants specified in these instructions, both prior to and during assembly.

Absolute cleanliness is to be ensured when performing repair work.

Continue: I01/1

SAFETY MEASURES

Component cleaning:
Armature, commutator end shield, solenoid switch and overrunning-clutch drive are only to be cleaned using compressed air (max. 4 bar) and a clean cloth. Use is never to be made of liquid cleaning agents.

Other parts such as planetary gear train (not plastic components) and drive-end bearing can be washed out with commercially available cleaning agent which is not readily flammable. Take care not to inhale vapours. Components must be re-lubricated or re-greased in line with lubrication schedule.

Continue: I09/2

SAFETY MEASURES

Danger of fire: Take care to avoid naked flames and sparking.

ATTENTION:
Make sure parts which have been cleaned are thoroughly dried, as gases subsequently forming in the sealed starting motor can lead to an explosion.

Always use the listed tools. Injuries cannot be precluded if use is made of incorrect and unsuitable tools and testers.

Continue: I10/1

SAFETY MEASURES

Danger of fire:

On starting motors provided with a busbar with thermoplastic sheathing (e.g. 0 001 125 5..), care is to be taken to ensure that the insulation is in proper condition and that the bolts have been tightened to the prescribed torque.

Continue: I10/2

SAFETY MEASURES

Always heed the following safety regulations:

* German Order governing the use of flammable liquids (VbF).
* Accident prevention regulations for electrical systems and equipment.
* Safety regulations for the handling of chlorinated hydrocarbons:
  - For companies: ZH 1/222
  - For employees: ZH 1/129

  issued by the German industrial liability insurance associations (central association for accident prevention and industrial medicine), Langwartweg 103, 53129 Bonn.

Continue: I11/1

SAFETY MEASURES

Outside Germany, pay attention to appropriate local regulations.

Skin protection:
To avoid skin irritation when handling oil and grease, apply hand cream before starting work and wash cream off when finished with soap and water.

Continue: I01/1

TESTERS, EQUIPMENT, TOOLS

All tools required for repairing starting motors of type DB are listed in the following.

Some of the tools needed have to be improvised in line with the drawings.

The type designation is given in parentheses for tools which used to be ordered on this basis.

Continue: I12/2

TESTERS, FIXTURES, TOOLS

Interturn short-circuit tester with test probes:	0 986 619 110
Test prods:	0 986 619 101
(Old version:	0 986 619 114)
Alternator tester WPG 012.00:	0 684 201 200
(alternatively, Motortester)	
Magnetic measurement stand:	4 851 601 124
Dial indicator:	1 687 233 011
Mandrel press:	comm. avail.

Continue: I13/1

TESTERS, FIXTURES, TOOLS

Clamping support:	0 986 619 362 (KDAW 9999)
Torque wrench (0...70 Nm):	comm. avail.
Torque meter (0.15...0.80 Nm):	0 986 617 206 (KDAL 5485)
Spring balance (2...12 N):	0 986 619 181 (KDAW 9991)

Continue: I13/2

TESTERS, FIXTURES, TOOLS

Assembly sleeve for starter versions with bushing (pinion ID 13.5 mm):	0 986 619 415
Disassembly sleeve for starter versions with bushing (pinion ID 13.5 mm):	0 986 619 416

Continue: I14/1

TESTERS, FIXTURES, TOOLS

Assembly sleeve for starter versions with needle bearing (pinion ID 14.7 mm): 0 986 619 406

Disassembly sleeve for starter versions with needle bearing (pinion ID 14.7 mm): 0 986 619 407

Collet chuck, comprising
* Basic chuck unit: 0 986 619 408
* Collet for pinions with 9 or 10 teeth: 0 986 619 412

Continue: I14/2

TESTERS, EQUIPMENT, TOOLS

Brush holder locating sleeve: 0 986 618 134 (KDLJ 6018)

Bushing puller: 0 986 617 243 (KDAL 5493)

Spring collet for bushings diameter 10 mm: 0 986 617 250 (KDAL 5493/0/7)

Pressing-in mandrel: 0 986 617 149 (KDAL 5058)

Continue: I15/1

TESTERS, FIXTURES, TOOLS

Tailstock chuck with Morse taper 2 for clamping diameter 5...45 mm for holding armature whilst turning down:	0 986 619 156 (KDAW 9987)
Slide caliper:	comm. avail.
Three-square scraper:	comm. avail.
Small cape chisel:	comm. avail.
V-blocks (2 off):	comm. avail.

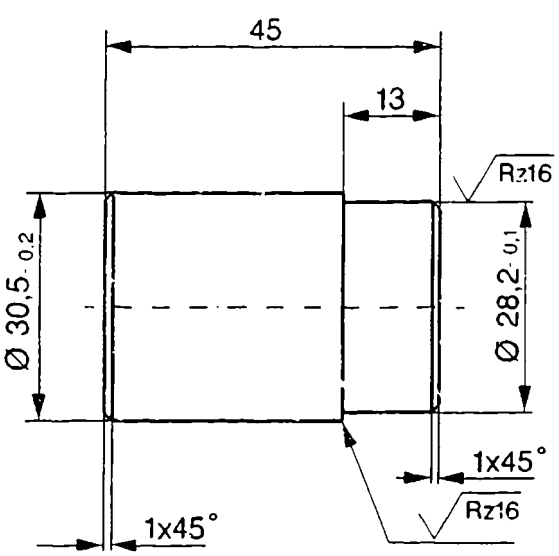
Continue: I16/1

TESTERS, EQUIPMENT, TOOLS

Pressing-out mandrel for bushing in drive-end bearing: to be improvised

Continue: I17/1 Fig.: I16/2

KMS00454



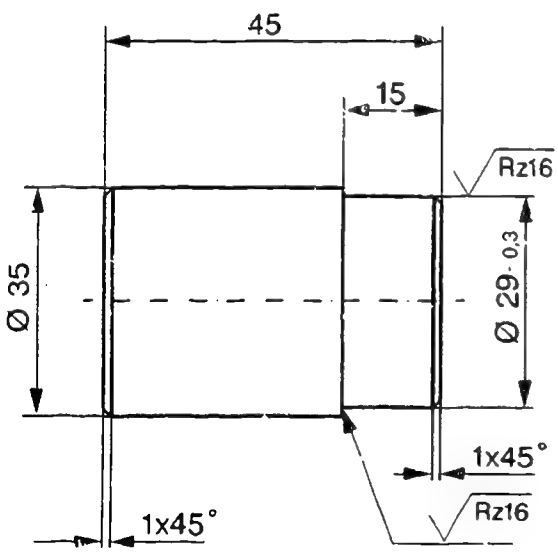
$\sqrt{Rz63}$ ($\sqrt{Rz16}$)

TESTERS, FIXTURES, TOOLS

Pressing-out mandrel
for needle bearing
in drive-end shield: Improvised tool

Continue: I18/1 Fig.: I17/2

KMS00529



$\sqrt{Rz63}$ ($\sqrt{Rz16}$)

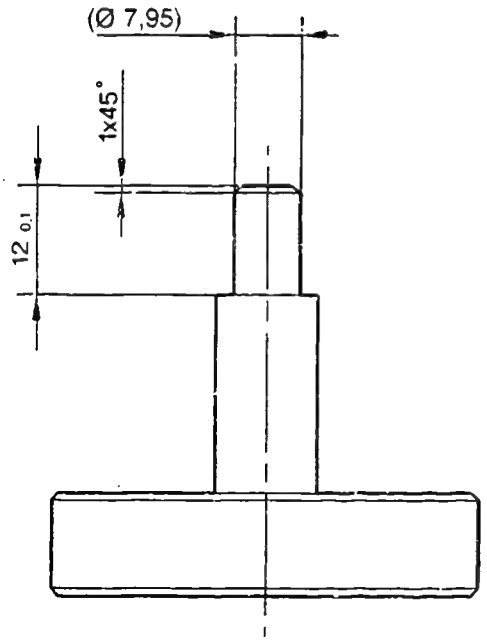
TESTERS, EQUIPMENT, TOOLS

Assembly stand for
planetary gear train: 0 986 617 138
(KDAL 5047)
(reworked version)

ATTENTION:
The 7.95 mm dia. pin at the assembly stand must be shortened to the dimension stated on the drawing.

Continue: I01/1 Fig.: I18/2

KMS00289



TEST SPECIFICATIONS AND SETTINGS

Commutator - minimum diameter:	31,2 mm
Radial run-out - Commutator:	< 0,01 mm
Armat. axial clearance:	0,2...0,75 mm

Continue: I19/2

TEST SPECIFICATIONS AND SETTINGS

Armature braking torque:	0,7...1,2 Nm
Clutch overrunning torque:	0,15...0,25 Nm
Carbon brush wear dimension x:	< 15 mm
Total pinion travel a:	12...15 mm

Continue: I20/1

TEST SPECIFICATIONS AND SETTINGS

Solenoid switch
pull-in voltage: 5...8 V

Solenoid switch resistances
* For starting motor 0 001 124 0..
  - Pull-in winding: 0,3...0,4 Ohm
  - Holding winding: 1,5...1,7 Ohm
* For starting motor 0 001 125 0..
  - Pull-in winding: 0,3...0,4 Ohm
  - Holding winding: 1,5...1,7 Ohm

* For starting motor 0 001 125 5..
  - Pull-in winding: 0,2...0,3 Ohm
  - Holding winding: 1,0...1,2 Ohm

Continue: I01/1

TIGHTENING TORQUES

Attachment of end plate of commutator end shield:	1,5...2,0 Nm
Attachment of commutator end shield and drive-end bearing	5,5...6,0 Nm
Solenoid switch attachment:	4,5...6,0 Nm
Brush holder connection, term. 45:	7...9 Nm
Connection, term. 30:	7...9 Nm
Attachment of busbar to drive-end bearing:	5,5...6,0 Nm

Continue: I01/1

LUBRICANTS/LUBRICATION SCHEDULE

General:

Commutator and carbon brushes are to be kept free of grease and oil.

Greased parts are to be degreased before re-lubricating them.

New bushings must be moistened prior to installation using suitable oil.
Oil VS 13 834-01: 5 962 260 000

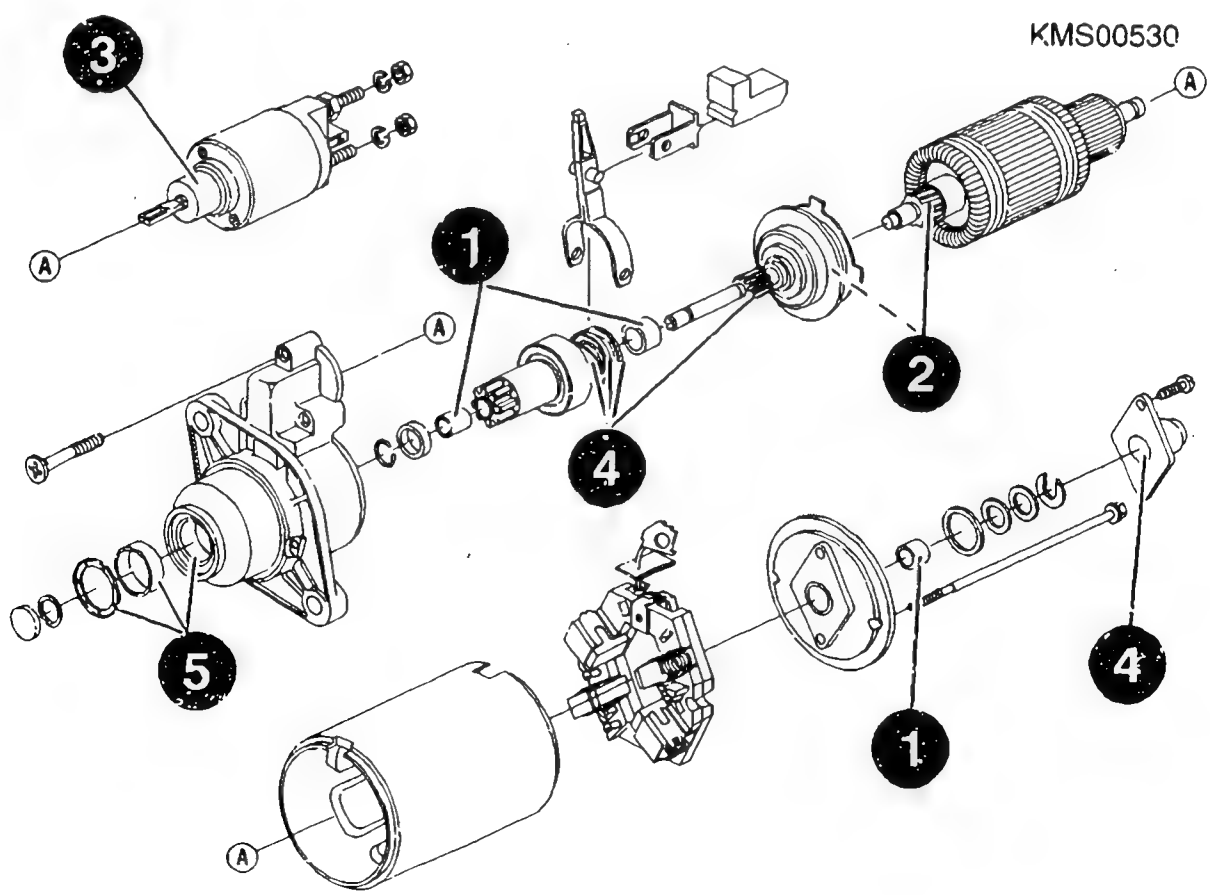
Continue: I23/1

LUBRICANTS/LUBRICATION SCHEDULE

Version with bushing in drive-end shield

1	=	Oil VS 13 834-01	5 962 260 000
2	=	Grease VS 16069-Ft	5 984 610 120
3	=	Grease VS 16634-Ft	5 990 260 000
4	=	Grease VS 18036-Ft	5 997 098 000
5	=	Grease VS 18099-Ft	5 997 287 000

Continue: I24/1 Fig.: I23/2

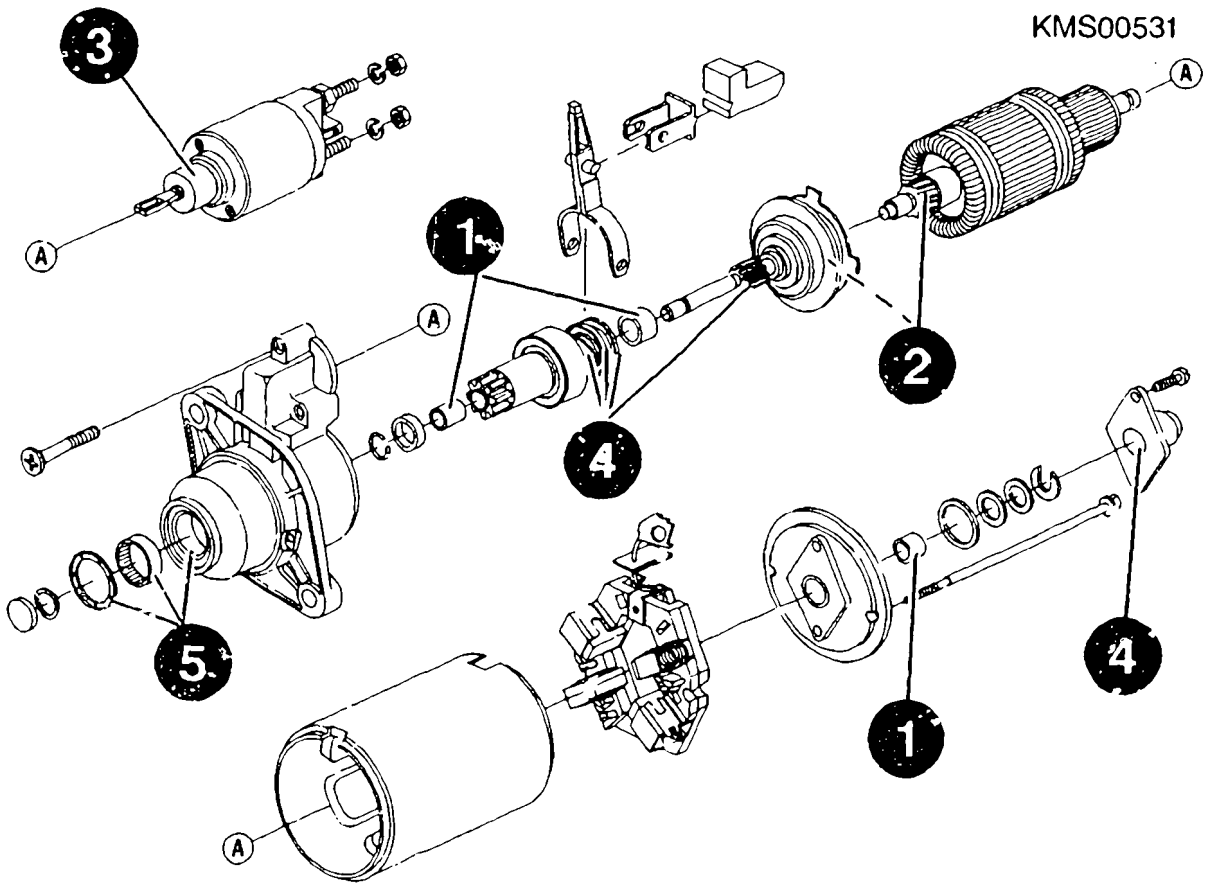


LUBRICANTS/LUBRICATION SCHEDULE

Version with needle bearing in drive-end shield

1	=	Oil VS 13 834-01	5 962 260 000
2	=	Grease VS 16069-Ft	5 984 610 120
3	=	Grease VS 16634-Ft	5 990 260 000
4	=	Grease VS 18036-Ft	5 997 098 000
5	=	Grease VS 18099-Ft	5 997 287 000

Continue: I01/1 Fig.: I24/2

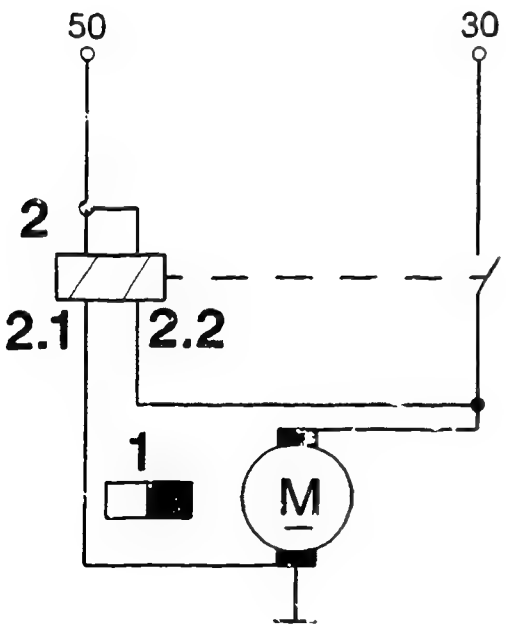


CIRCUIT DIAGRAM

1 = Exciter field
(permanent magnet)
2 = Solenoid switch
2.1 = Holding winding
2.2 = Pull-in winding

Continue: I01/1 Fig.: I25/2

KMS00394



STARTER DISASSEMBLY TABLE

Continue: I01/1

STARTING-MOTOR DISASSEMBLY

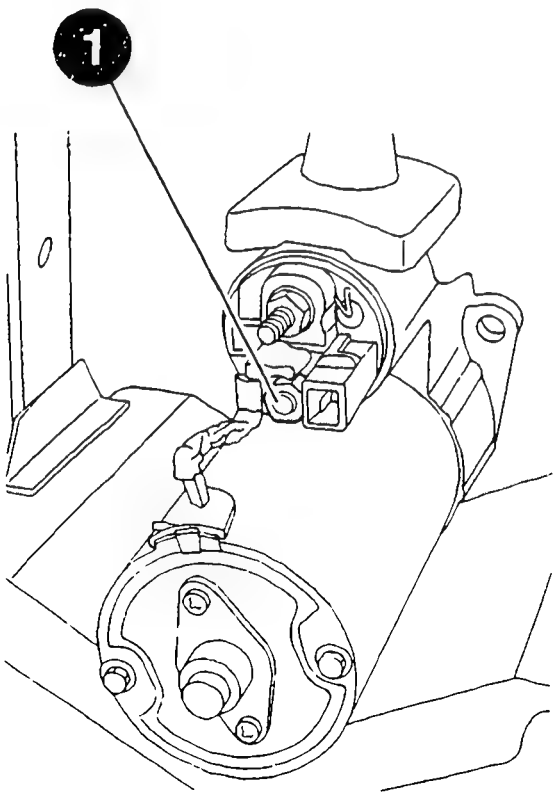
Solenoid-switch disassembly

Clamp starting motor in clamping support. Unfasten connection (1) of excitation winding at solenoid switch.

Clamping support: 0 986 619 362

Continue: I28/1 Fig.: I27/2

KMS00395



STARTING MOTOR DISASSEMBLY

Disassembling solenoid switch

Mark position of solenoid switch.
Unfasten solenoid switch bolts.

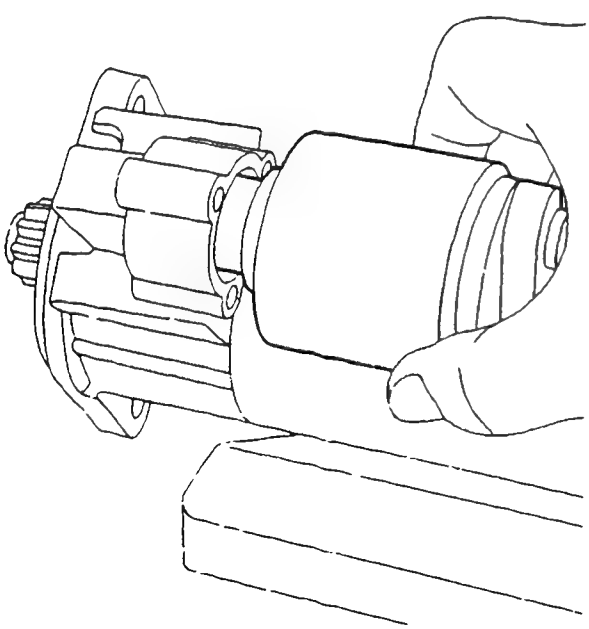
DANGER OF ACCIDENT

The pretensioned return spring causes the solenoid switch to be pressed down by the switch armature.

Pull solenoid switch off switch armature. Pay attention to return spring in solenoid switch armature.

Continue: II01/1 Fig.: I28/2

KMS00396



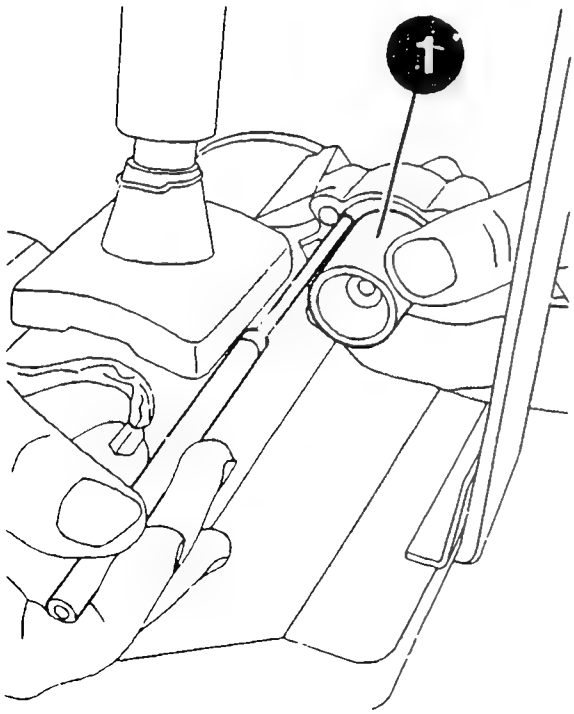
STARTING MOTOR DISASSEMBLY

Disassembling solenoid switch

Use suitable tool to pull back engaging lever and disengage solenoid switch armature (1) at engaging lever.

Continue: I26/1 Fig.: I101/2

KMS00397



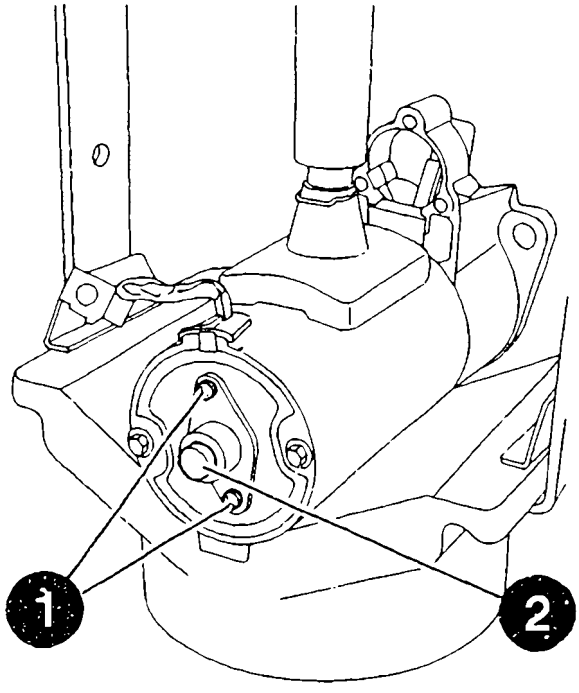
STARTING MOTOR DISASSEMBLY

Disassembling bearing-end plate

Unfasten bolts (1) of bearing-end plate (2). Remove bearing-end plate with sealing ring.

Continue: I26/1 Fig.: II02/2

KMS00398



STARTING MOTOR DISASSEMBLY

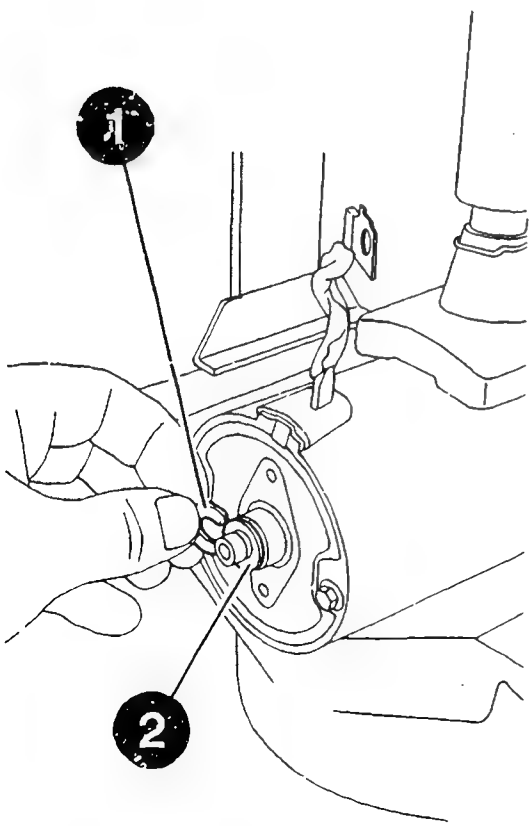
Disassembling commutator end shield

Remove positioning washer (1) of armature shaft and shim (2).

NOTE: If there is any burr at the armature shaft groove, start by removing this burr with an oilstone or the like.

Continue: II04/1 Fig.: II03/2

KMS00399



STARTING MOTOR DISASSEMBLY

Disassembling commutator end shield

Unfasten bolts (1).

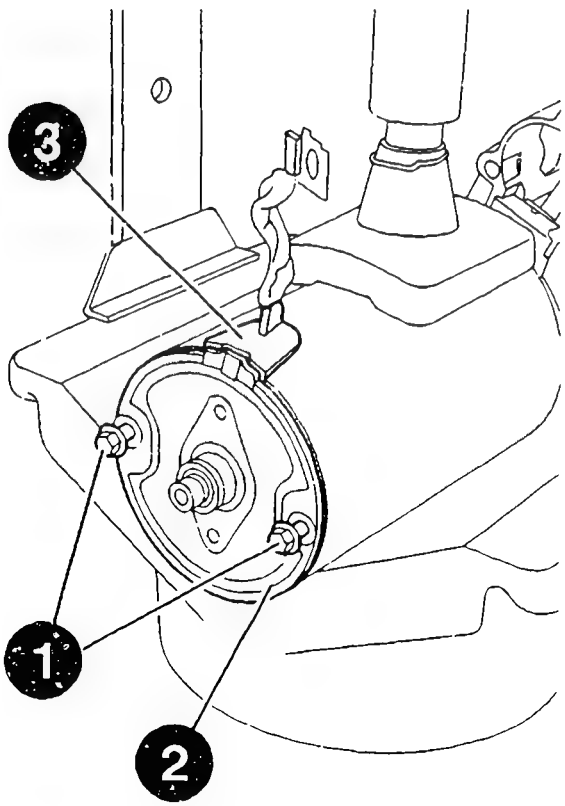
Remove commutator end shield (2) from stator frame, taking care not to damage gasket (3).

DANGER OF INJURY

The drive-end bearing is not fixed in position with respect to the stator frame.

Continue: I26/1 Fig.: II04/2

KMS00400



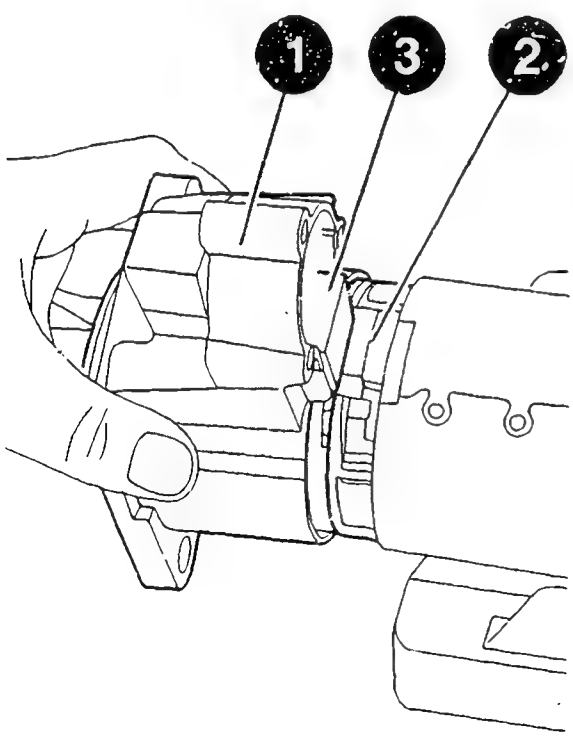
DISASSEMBLING STARTER

Disassembling drive-end shield

Pull drive-end shield (1) off planetary gear (2).
Detach rubber seal (3).

Continue: I26/1 Fig.: II05/2

KMS00514



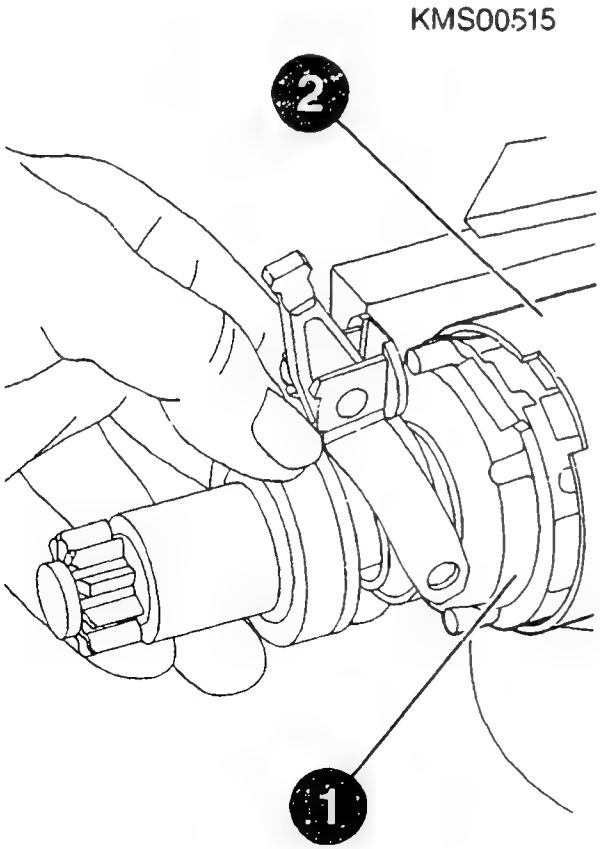
DISASSEMBLING STARTER

Disassembling overrunning clutch and planetary gear

Pull planetary gear (1) out of stator housing (2).

Slip assembly horizontally onto assembly stand and position vertically to avoid damage.
Assembly stand for planetary gear (reworked): 0 986 617 138

Continue: I26/1 Fig.: II06/2



STARTING MOTOR DISASSEMBLY

Disassembling armature

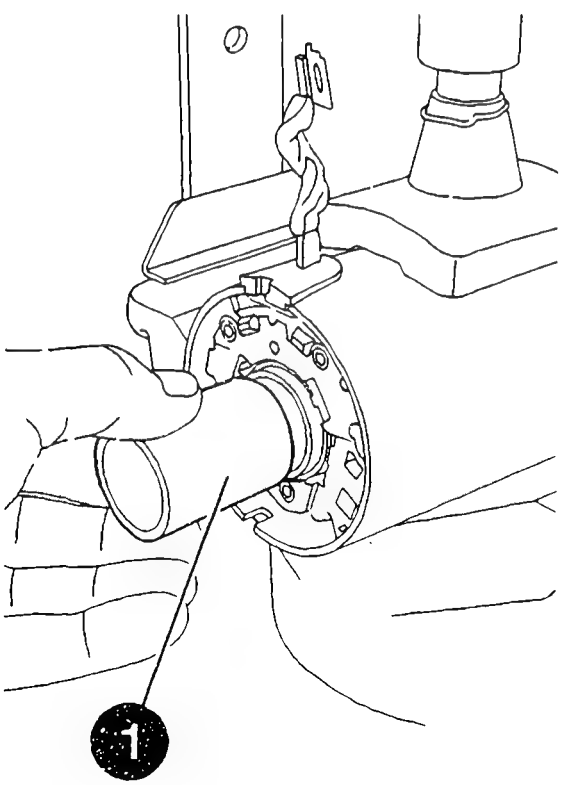
Attach locating sleeve (1) to armature shaft from commutator end.

ATTENTION: Make sure thread of locating sleeve does not damage armature shaft.

Brush holder locating sleeve: 0 986 618 134

Continue: II08/1 Fig.: II07/2

KMS00402



STARTING MOTOR DISASSEMBLY

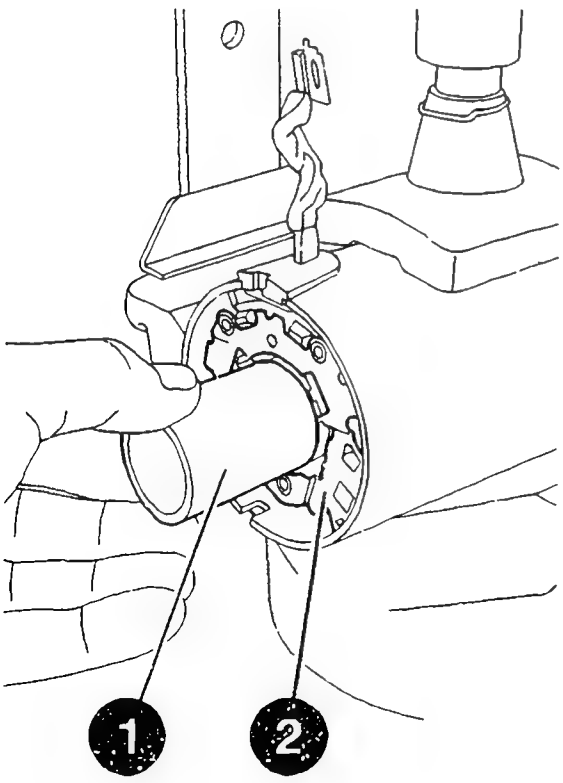
Disassembling armature

Carefully pull armature against force of permanent magnet out of stator frame towards drive-end bearing side and in doing so insert locating sleeve (1) into brush holder (2).

The carbon brushes must rest on the tool.

Continue: I26/1 Fig.: II08/2

KMS00403



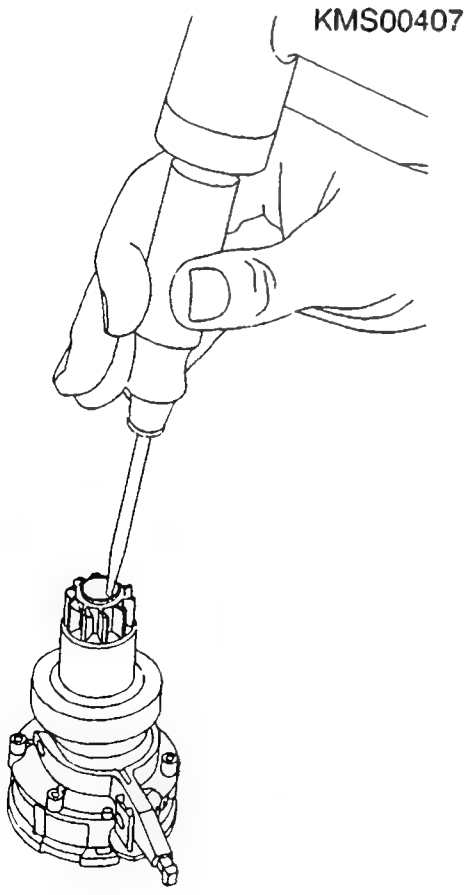
STARTING MOTOR DISASSEMBLY

Disassembling cap

Use plastic-headed hammer to gently tap suitable tool into the edge of the cap (see Fig.) and prise off cap.

DANGER OF INJURY

Continue: I26/1 Fig.: II09/2



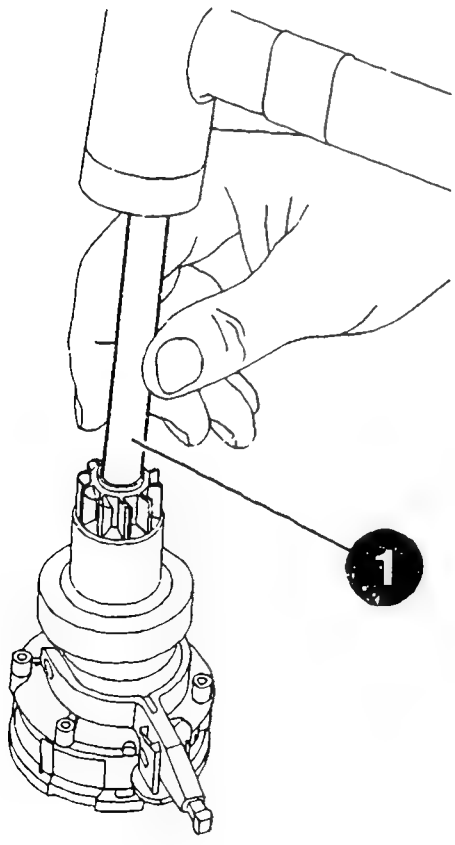
DISASSEMBLING STARTER

Disassembling overrunning clutch

Slip disassembly sleeve (1) over output shaft and position on stop ring. Knock back stop ring by tapping firmly (plastic-headed hammer) on disassembly sleeve.
The following disassembly sleeve is required depending on starter version:
- Starter versions with bushing (pinion ID 13.5 mm): 0 986 619 416
- Starter versions with needle bearing (pinion ID 14.7 mm): 0 986 619 407

Continue: II11/1 Fig.: II10/2

KMS00408



STARTING MOTOR DISASSEMBLY

Disassembling overrunning-clutch drive

Use suitable tool to remove snap ring (1) from output shaft.

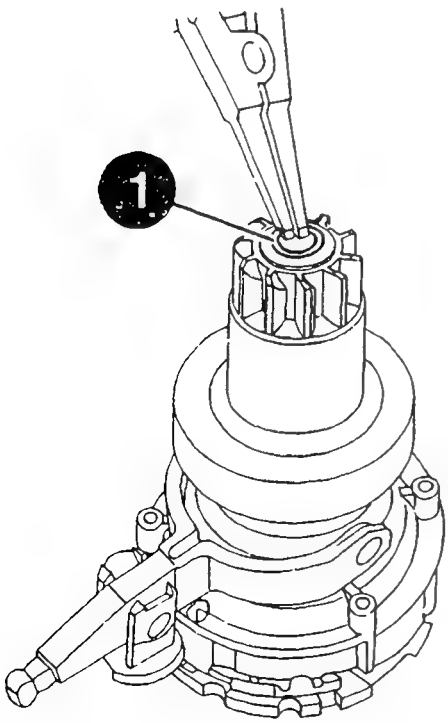
Take care not to damage output shaft.

DANGER OF INJURY

The pretension may cause the snap ring to spring off the output shaft.

Continue: II12/1 Fig.: II11/2

KMS00409



STARTING MOTOR DISASSEMBLY

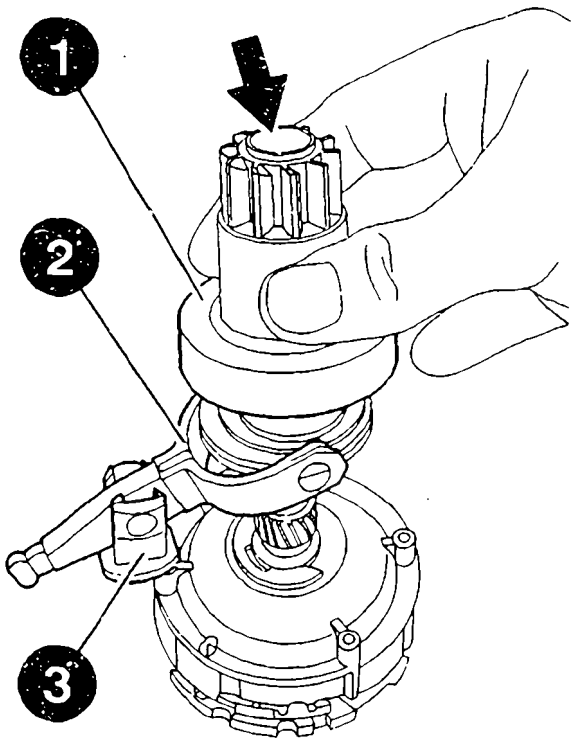
Disassembling overrunning-clutch drive

Remove overrunning-clutch drive (1) with engaging lever (2) and mount (3) from output shaft.

Pay attention to stop ring in pinion hole (see arrow).

Continue: I01/1 Fig.: II12/2

KMS00410



COMPONENT CLEANING

Component cleaning:
Armature, commutator end shield, solenoid switch and overrunning-clutch drive are only to be cleaned using compressed air (max. 4 bar) and a clean cloth. Use is never to be made of liquid cleaning agents.

Other parts such as planetary gear train (not plastic components) and drive-end bearing can be washed out with commercially available cleaning agent which is not readily flammable. Take care not to inhale vapours. Components must be re-lubricated or re-greased in line with lubrication schedule.

Continue: II13/2

COMPONENT CLEANING

Danger of fire: Take care to avoid naked flames and sparking.

ATTENTION:
Make sure parts which have been cleaned are thoroughly dried, as gases subsequently forming in the sealed starting motor can lead to an explosion.

Continue: II14/1

COMPONENT CLEANING

Always heed the following safety regulations:

* German Order governing the use of flammable liquids (VbF).
* Accident prevention regulations for electrical systems and equipment.
* Safety regulations for the handling of chlorinated hydrocarbons:
  - For companies: ZH 1/222
  - For employees: ZH 1/129

  issued by the German industrial liability insurance associations (central association for accident prevention and industrial medicine), Langwartweg 103, 53129 Bonn.

Continue: II14/2

COMPONENT CLEANING

Outside Germany, pay attention to appropriate local regulations.

Skin protection:
To avoid skin irritation when handling oil and grease, apply hand cream before starting work and wash cream off when finished with soap and water.

Continue: I01/1

TESTING/REPAIR TABLE

Continue: II15/2

TESTING/REPAIR TABLE

Continue: I01/1

COMPONENT TESTING AND REPAIR

Testing pinion

Meshing pinion and overruning-clutch drive are subject to considerable wear. Overruning-clutch drive is therefore always to be replaced.

Continue: II15/1

COMPONENT CHECKING AND REPAIR

Checking drive-end shield (version with bushing)

Radial lip-type oil seal and bushing of drive-end shield are always to be replaced.

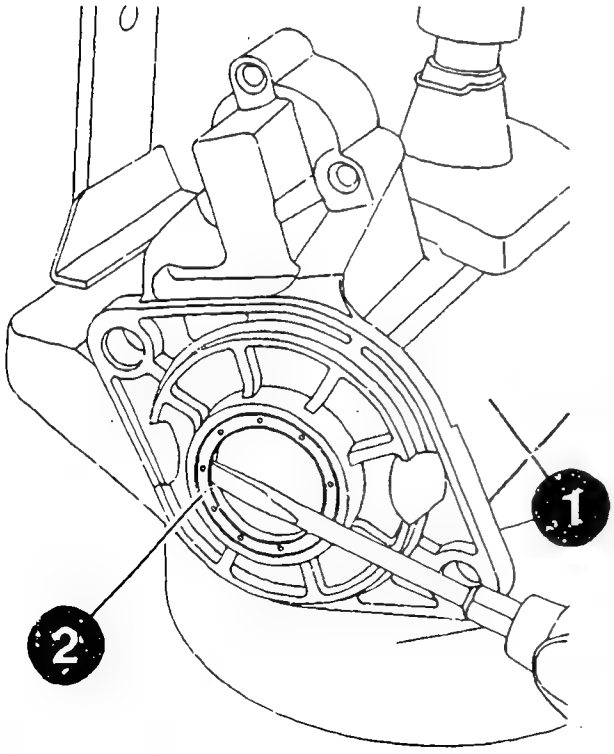
Removing radial lip-type oil seal:
Clamp drive-end shield (1) in clamping support.

Use suitable tool to prise out radial lip-type oil seal (2).

Clamping support: 0 986 619 362

Continue: II18/1 Fig.: II17/2

KMS00516



COMPONENT CHECKING AND REPAIR

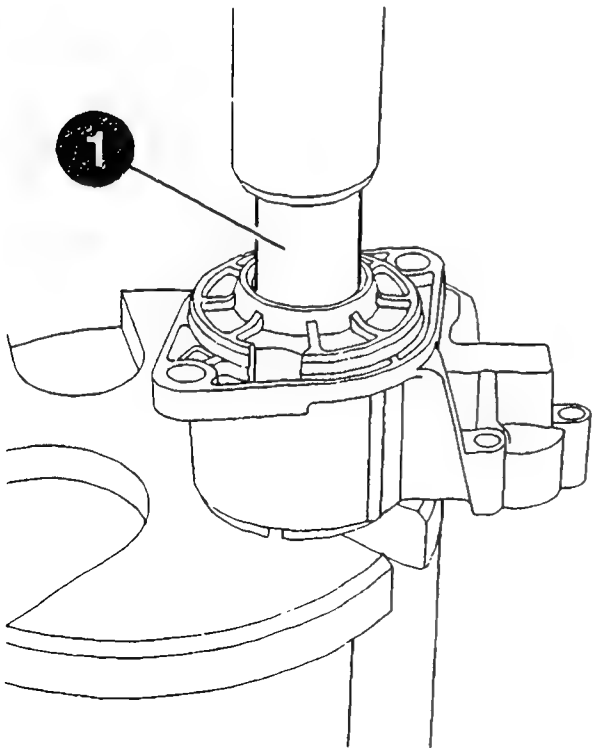
Checking drive-end shield (version with bushing)

Removing bushing:
Press out bushing inwards with pressing-out mandrel (1).

Mandrel press: comm. avail.
Pressing-out mandrel: improvised tool

Continue: II19/1 Fig.: II18/2

KMS00412



COMPONENT CHECKING AND REPAIR

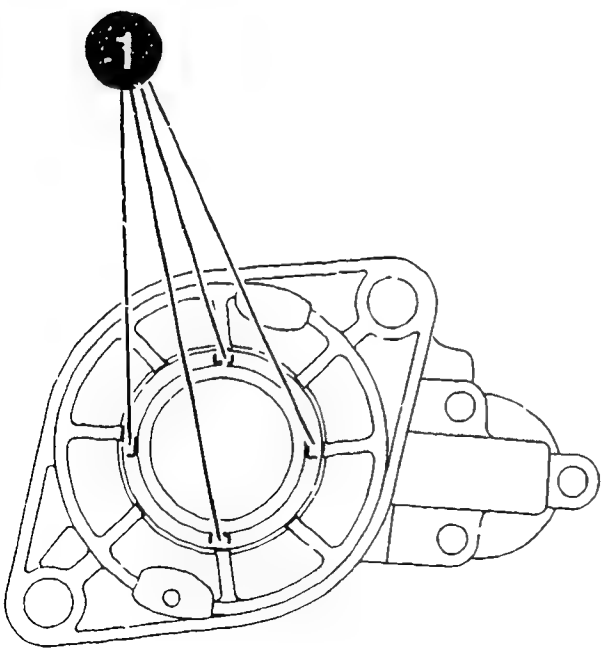
Checking drive-end shield (version with bushing)

After removing radial lip-type oil seal and bushing, use three-square scraper to carefully remove projecting caulking material (1).
ATTENTION: Take care not to damage fitting surfaces of shield and oil seal seat.

Three-square scraper: comm. avail.

Continue: II20/1 Fig.: II19/2

KMS00413



COMPONENT CHECKING AND REPAIR

Checking drive-end shield (version with bushing)

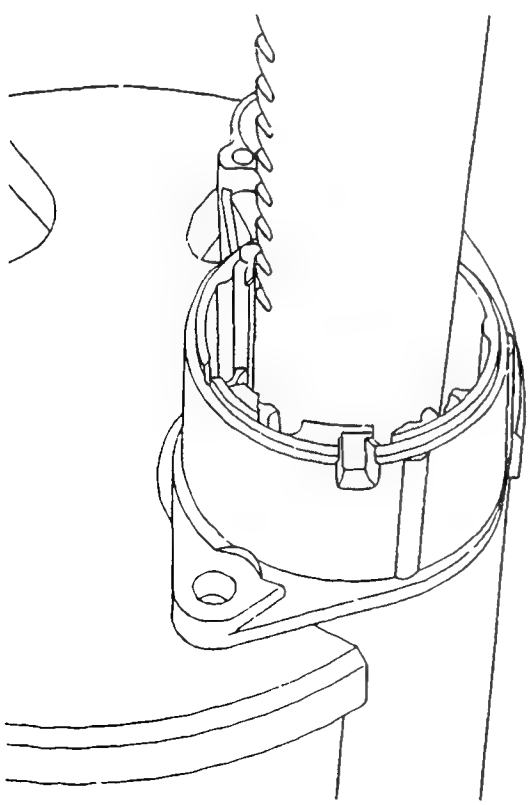
Installing bushing:
Use mandrel of mandrel press to carefully flush-fit bushing in drive-end shield from inside.

ATTENTION: Pockets of new bushing must be completely filled with grease.

Mandrel press:	comm. avail.
Grease VS 18099 Ft:	5 997 287 000

Continue: II21/1 Fig.: II20/2

KMS00414



COMPONENT CHECKING AND REPAIR

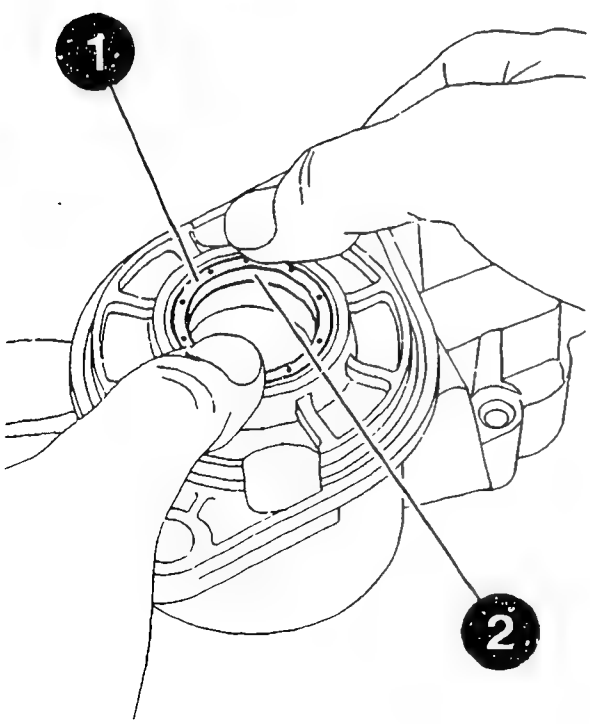
Checking drive-end shield (version with bushing)

Installing radial lip-type oil seal:
Fill seat of radial lip-type oil seal in drive-end shield with grease. Press home radial lip-type oil seal (1) by hand in drive-end shield.
ATTENTION: Side of oil seal with groove (arrow) must be pointing upwards.
Remaining space (2) between oil seal and bushing must be completely filled with grease.

Grease VS 18099 Ft: 5 997 287 000

Continue: II22/1 Fig.: II21/2

KMS00517



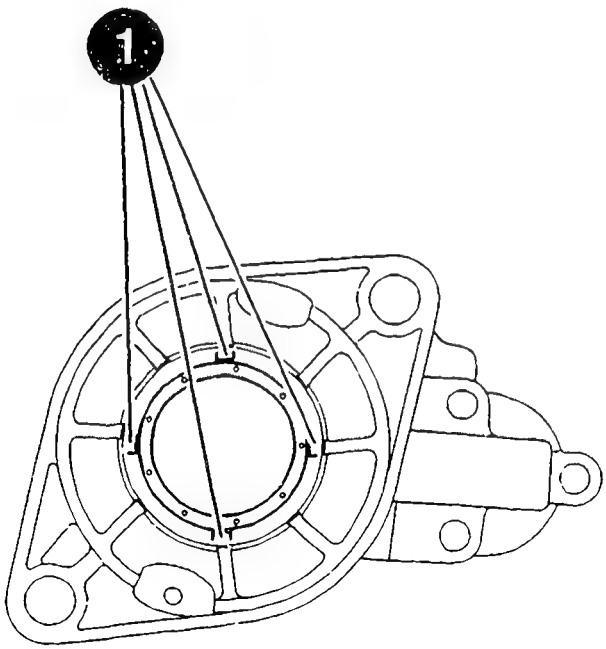
Checking drive-end shield (version with bushing)

Installing radial lip-type oil seal contd.:
Use small cape chisel to caulk drive-end shield at four locations (1) (offset by 90 in each case) to ensure tight fit of radial lip-type oil seal.
Take care not to damage machined seat of radial lip-type oil seal.
Remove surplus grease after installation.

Small cape chisel: comm. avail.

Continue: II15/1 Fig.: II22/2

KMS00518



COMPONENT CHECKING AND REPAIR

Checking drive-end shield (version with needle bearing)

Radial lip-type oil seal and bushing of drive-end shield are always to be replaced.

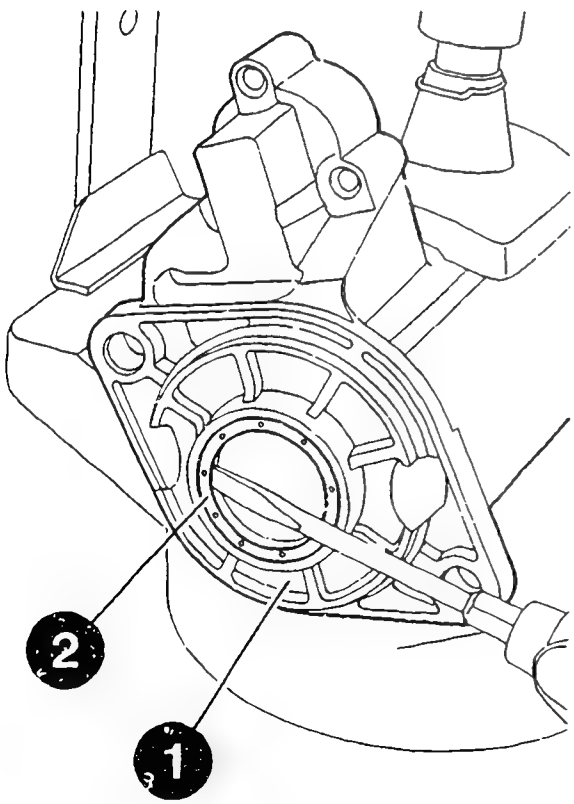
Removing radial lip-type oil seal:
Clamp drive-end shield (1) in clamping support.

Use suitable tool to prise out radial lip-type oil seal (2).

Clamping support: 0 986 619 362

Continue: II24/1 Fig.: II23/2

KMS00532



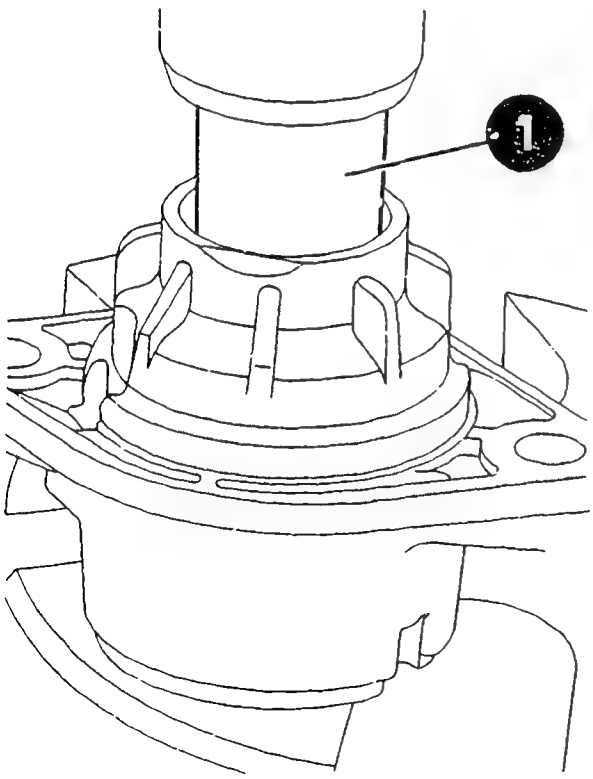
COMPONENT CHECKING AND REPAIR

Checking drive-end shield (version with needle bearing)

Removing needle bearing:
use pressing-out mandrel (1) to press out needle bearing inwards.
Mandrel press: comm. avail.
Pressing-out mandrel: improvised tool

Continue: II25/1 Fig.: II24/2

KMS00533



COMPONENT CHECKING AND REPAIR

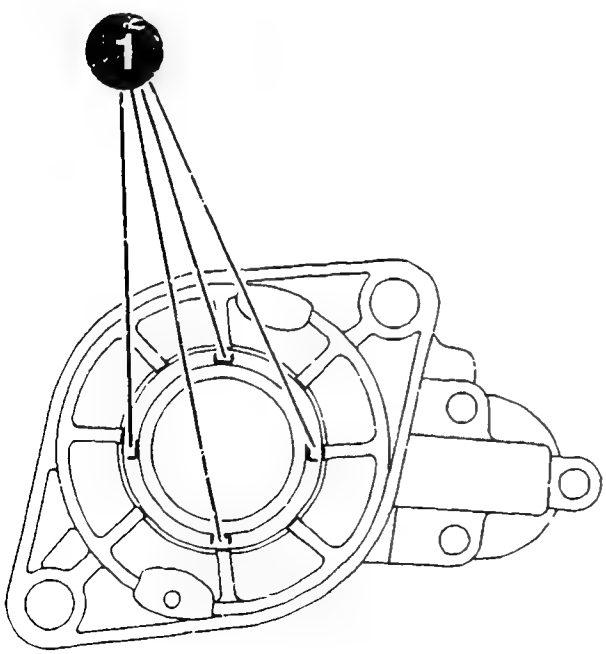
Checking drive-end shield (version with needle bearing)

After removing radial lip-type oil seal and needle bearing, use three-square scraper to carefully remove projecting caulking material (1).
ATTENTION: Take care not to damage fitting surfaces of shield and oil seal seat.

Three-square scraper: comm. avail.

Continue: II26/1 Fig.: II25/2

KMS00413



COMPONENT CHECKING AND REPAIR

Checking drive-end shield (version with needle bearing)

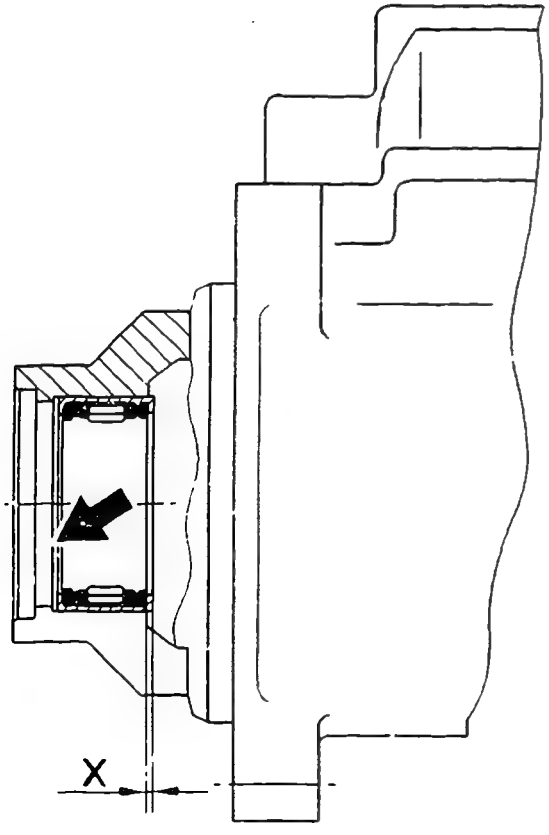
Installing needle bearing: ASSEMBLY INSTRUCTIONS

* Pay attention to dimension "X" in drawing when pressing in.
* Never press in needle bearing as far as stop at housing collar (arrow).

Dimension "X": 0...0,3 mm

Continue: II27/1 Fig.: II26/2

KMS00534



COMPONENT CHECKING AND REPAIR

Checking drive-end shield (version with needle bearing)

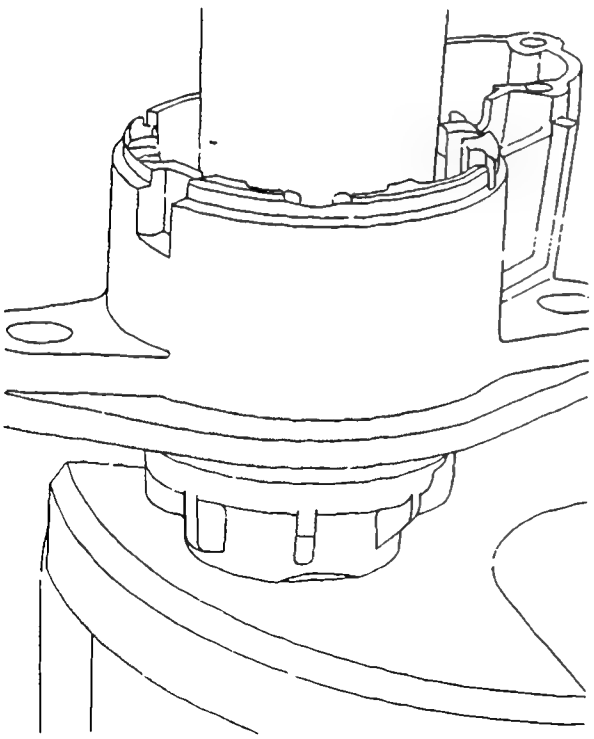
Installing needle bearing:

ATTENTION: Heed assembly instructions. Use mandrel of press to carefully fit needle bearing in drive-end shield from inside. Pay attention to dimension "X".

Mandrel press:	comm. avail.
Grease VS 18099 Ft:	5 997 287 000

Continue: II28/1 Fig.: II27/2

KMS00535



COMPONENT CHECKING AND REPAIR

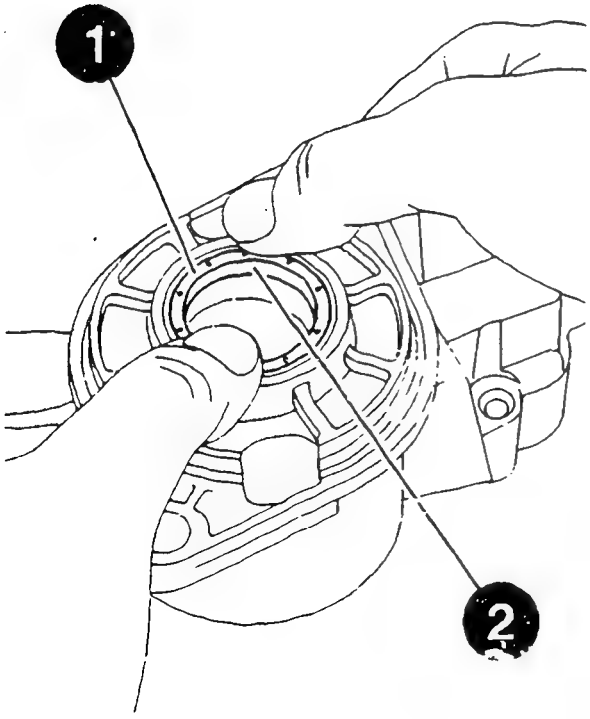
Checking drive-end shield (version with needle bearing)

Installing radial lip-type oil seal:
Fill seat of radial lip-type oil seal in drive-end shield with grease. Press home radial lip-type oil seal (1) by hand in drive-end shield.
ATTENTION: Side of oil seal with groove (arrow) must be pointing upwards.
Remaining space (2) between oil seal and needle bearing must be completely filled with grease.

Grease VS 18099 Ft: 5 997 287 000

Continue: III01/1 Fig.: II28/2

KMS00517



COMPONENT CHECKING AND REPAIR

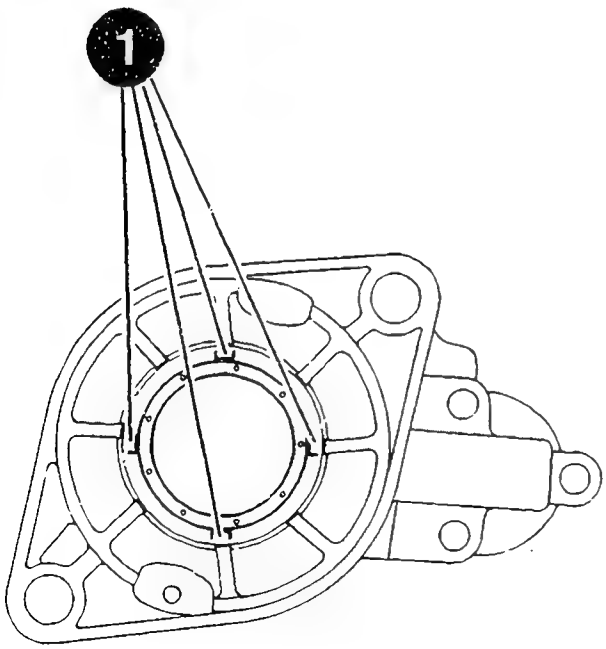
Checking drive-end shield (version with needle bearing)

Installing radial lip-type oil seal contd.:
Use small cape chisel to caulk drive-end shield at four locations (1) (offset by 90 in each case) to ensure tight fit of radial lip-type oil seal.
Take care not to damage machined seat of radial lip-type oil seal.
Remove surplus grease after installation.

Small cape chisel: comm. avail.

Continue: II15/1 Fig.: III01/2

KMS00518



COMPONENT TESTING AND REPAIR

Checking commutator end shield

Check bushing for damage and scoring.

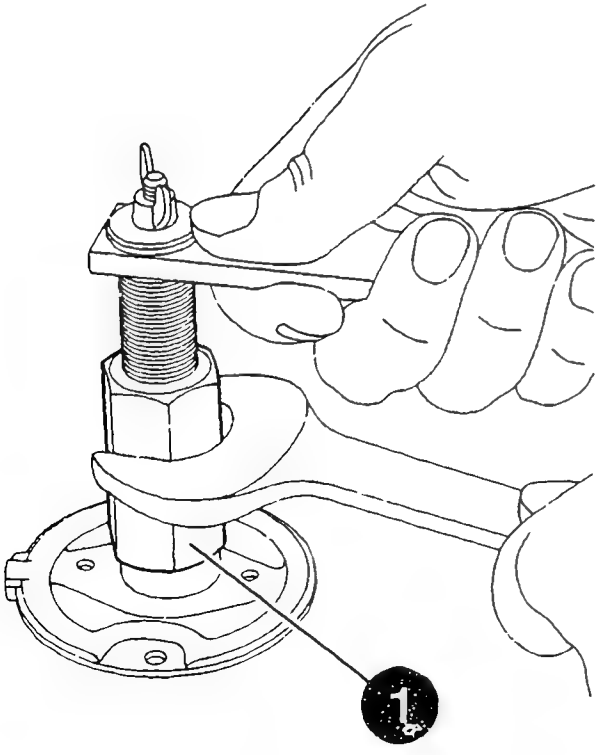
Replace if necessary.

Removal: Use puller (1) and spring collet to pull bushing out of commutator end shield.

Puller:	0 986 617 243
Spring collet diameter 10 mm:	0 986 617 250

Continue: III03/1 Fig.: III02/2

KMS00417



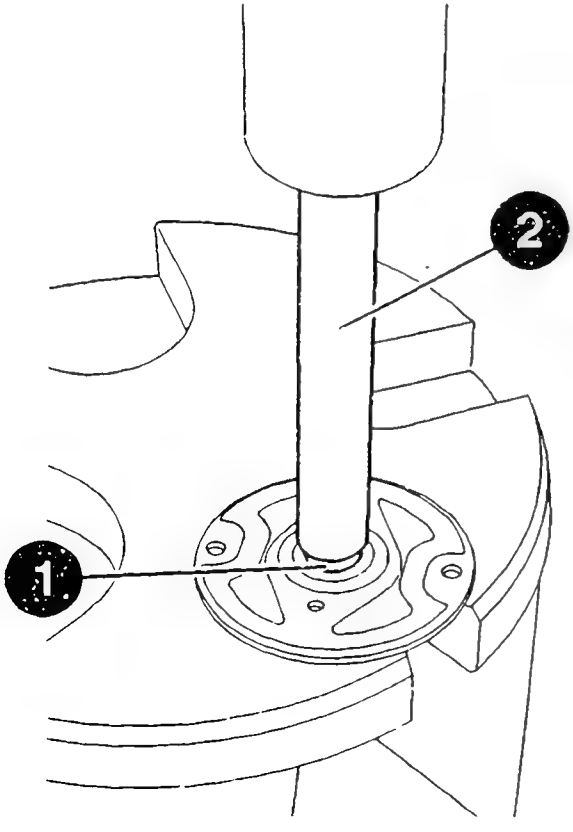
Checking commutator end shield

Installation: Use pressing-in mandrel (2) to press new bushing (1) from inside (see Fig.) into commutator end shield such that it ends 0.2...0.4 mm before outer collar of commutator end shield.
If necessary, press in to required dimension using old bushing.
ATTENTION: New bushing must be moistened beforehand with suitable oil.

Mandrel press:	comm. avail.
Pressing-in mandrel:	0 986 617 1[illegible]
Oil VS 13 834-01:	5 962 260 0[illegible]

Continue: II15/1 Fig.: III03/2

KMS00418



COMPONENT TESTING AND REPAIR

Checking overrunning-clutch drive

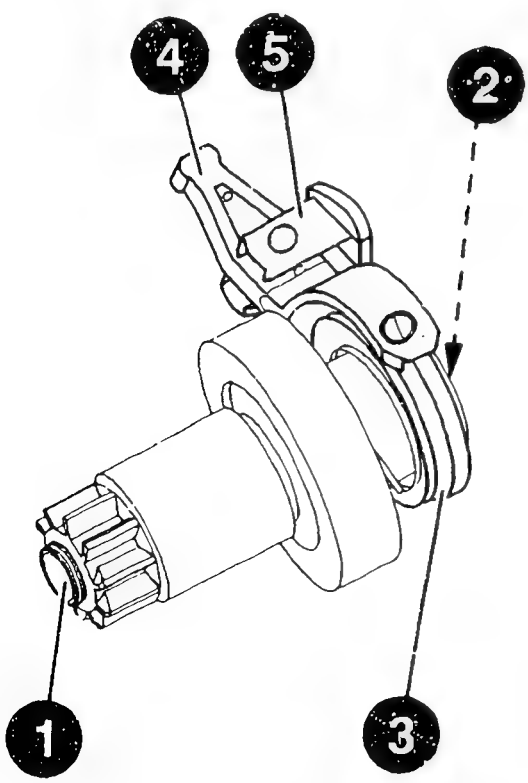
Pinion, bushings (1), spiral spline (2) and driver edges (3) of overrunning-clutch drive are subject to a high degree of wear.

The overrunning-clutch drive is thus always to be replaced.

Also replace engaging lever (4) and its mount (5).

Continue: III05/1 Fig.: III04/2

KMS00482



COMPONENT TESTING AND REPAIR

Checking overrunning-clutch drive

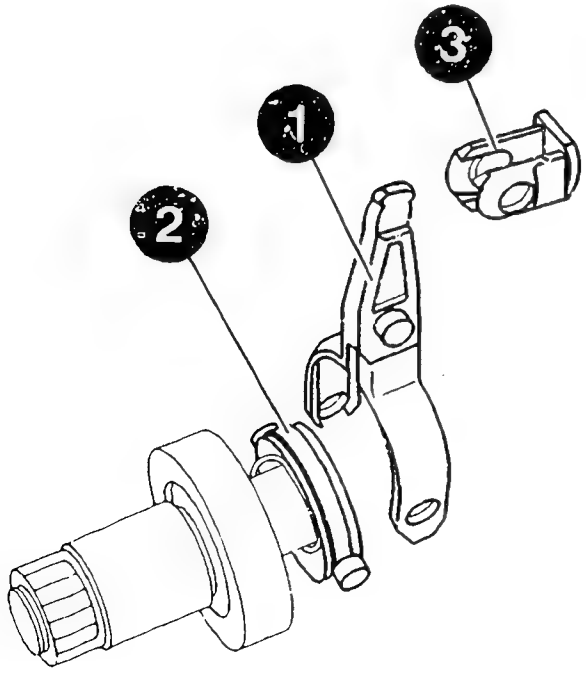
Engage new engaging lever (1) at driver (2) on overrunning-clutch drive.

Engage new mount (3) at engaging lever with open end facing pinion.

NOTE: Fig. shows disassembled engaging lever and mount.

Continue: II15/1 Fig.: III05/2

KMS00481



COMPONENT TESTING AND REPAIR

Checking planetary gear train

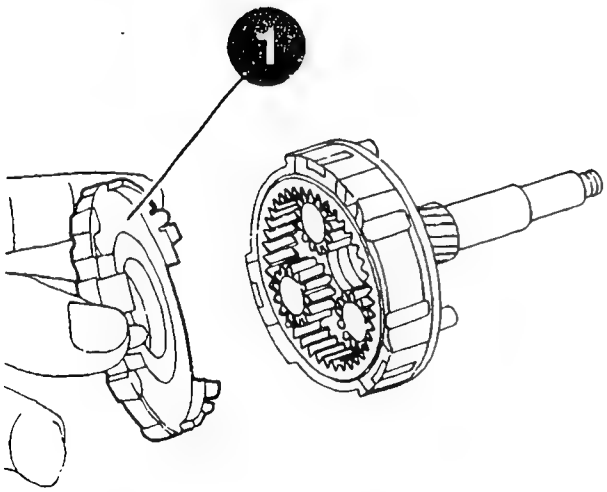
Disassembly:

Remove assembly from assembly stand.

Remove cover (1).

Continue: III07/1 Fig.: III06/2

KMS00419



Checking planetary gear train

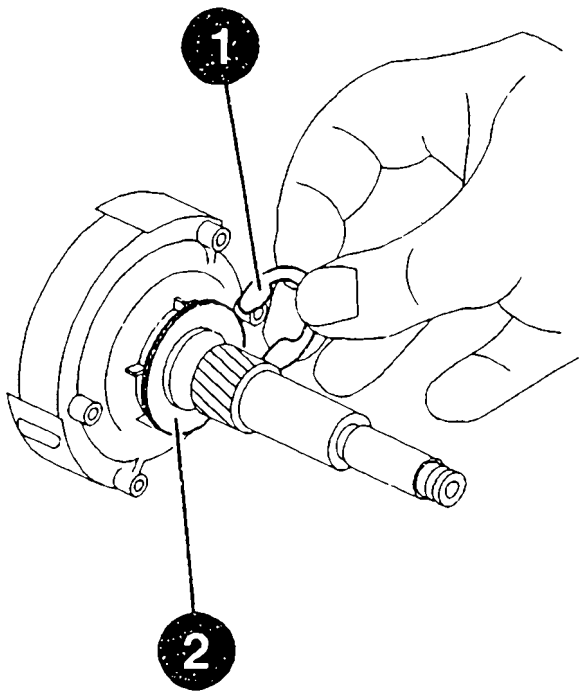
Disassembly (continued):

Remove circlip (1) and detach washer (2).

Pull output shaft out of gear shell.

Continue: III08/1 Fig.: III07/2

KMS00480



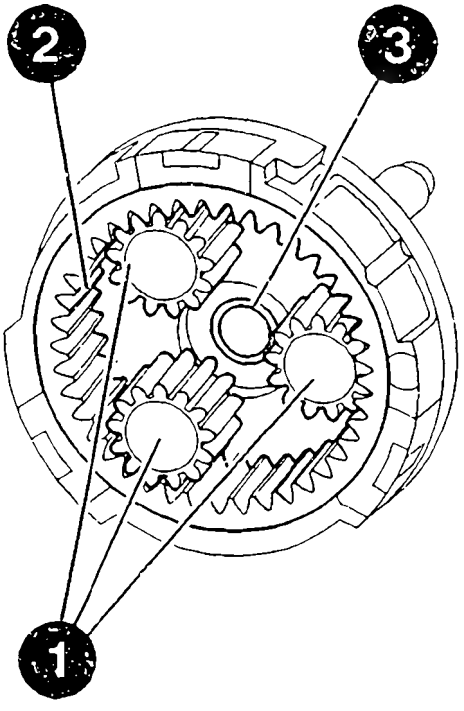
COMPONENT TESTING AND REPAIR

Checking planetary gear train

The complete planetary gear train must be replaced if the planet gears (1), the internal geared wheel (2) or the sun gear bushing (3) are/is worn.

Continue: III09/1 Fig.: III08/2

KMS00420

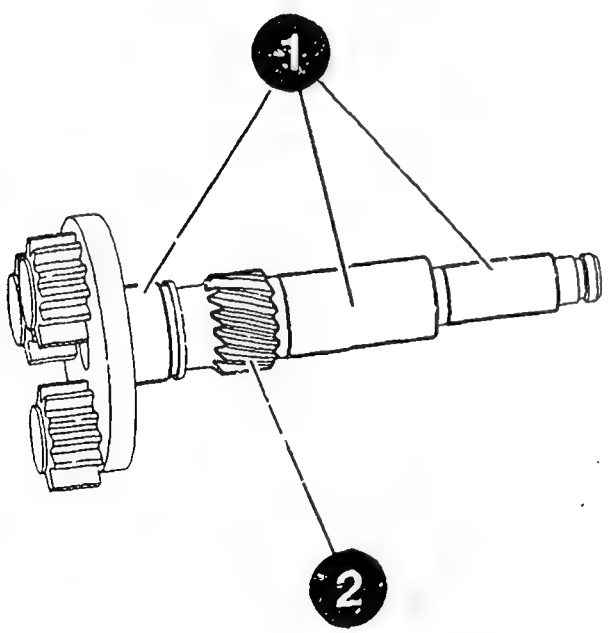


Checking planetary gear train

The complete planetary gear train must also be replaced if one of the bearing surfaces (1) on the output shaft or the spiral spline (2) is worn or damaged.

Continue: III10/1 Fig.: III09/2

KMS00421



COMPONENT TESTING AND REPAIR

Checking planetary gear train

Assembly:

Lubricate in line with lubrication schedule during assembly.

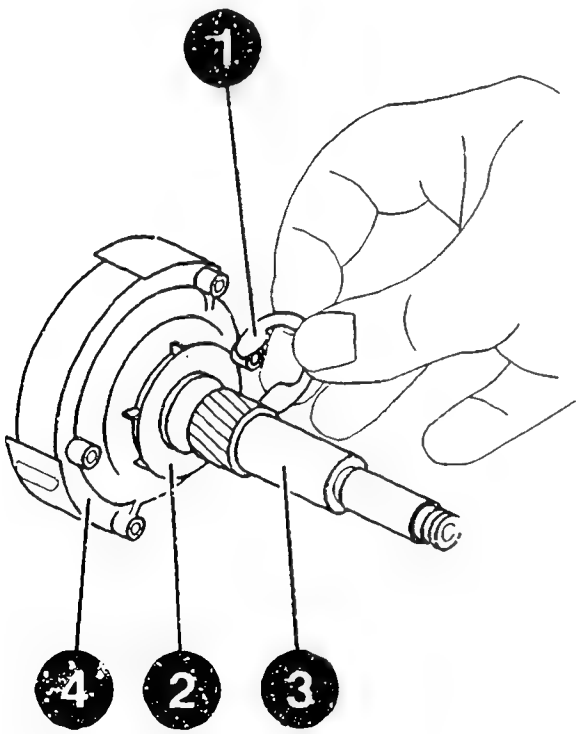
Insert output shaft (3) in gear shell (4).

Slip washer (2) onto output shaft. Secure circlip (1).

Grease VS 16069-FT: 5 984 610 120

Continue: III11/1 Fig.: III10/2

KMS00483



Checking planetary gear train

Assembly (continued):

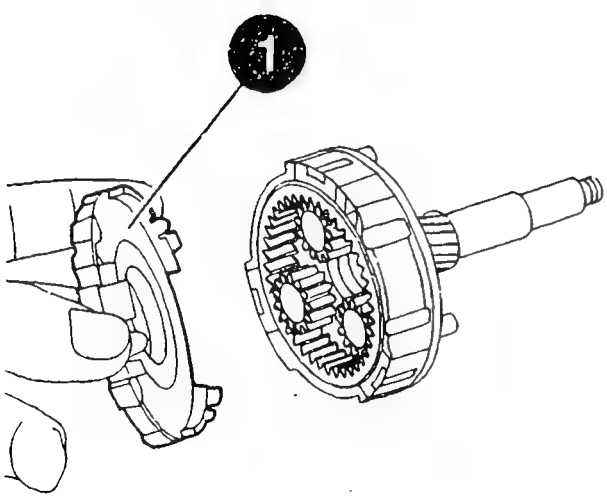
Fit cover (1). Pay attention to correct position of holes for bolts.

Slip planetary gear train onto assembly stand and position it vertically.

Assembly stand for planetary gear train (reworked version): 0 986 617 138

Continue: II15/1 Fig.: III11/2

KMSC0419



COMPONENT TESTING AND REPAIR

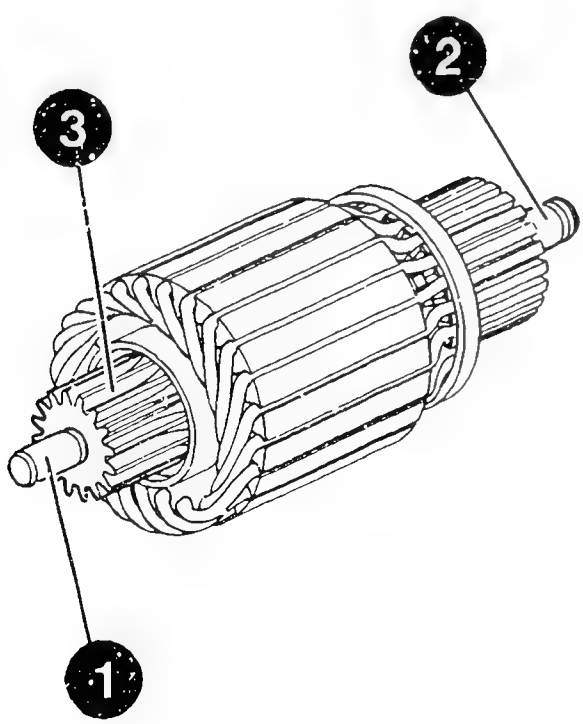
Checking armature

Examine bearing surface of sun gear bushing (1) and commutator end shield (2), as well as sun gear (3) for scoring and damage.

Replace armature if necessary.

Continue: III13/1 Fig.: III12/2

KMS00319



COMPONENT TESTING AND REPAIR

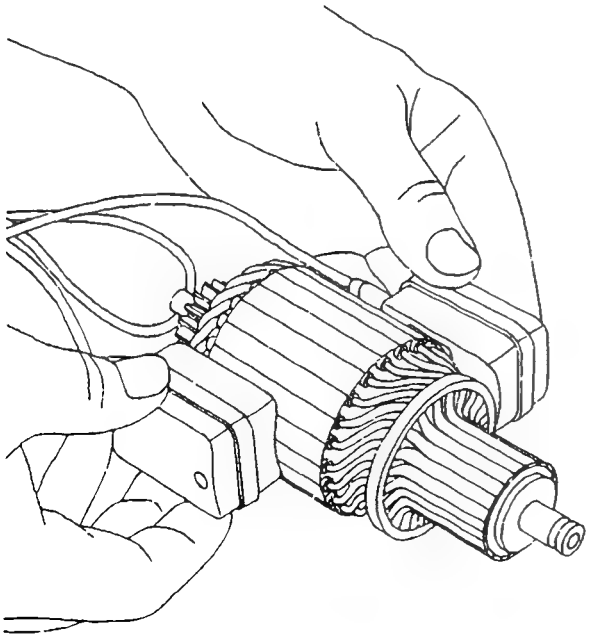
Testing armature

Check armature for interturn short circuit using tester and test probes.

Interturn short-circuit tester with test probes: 0 986 619 110

Continue: III14/1 Fig.: III13/2

KMS00320



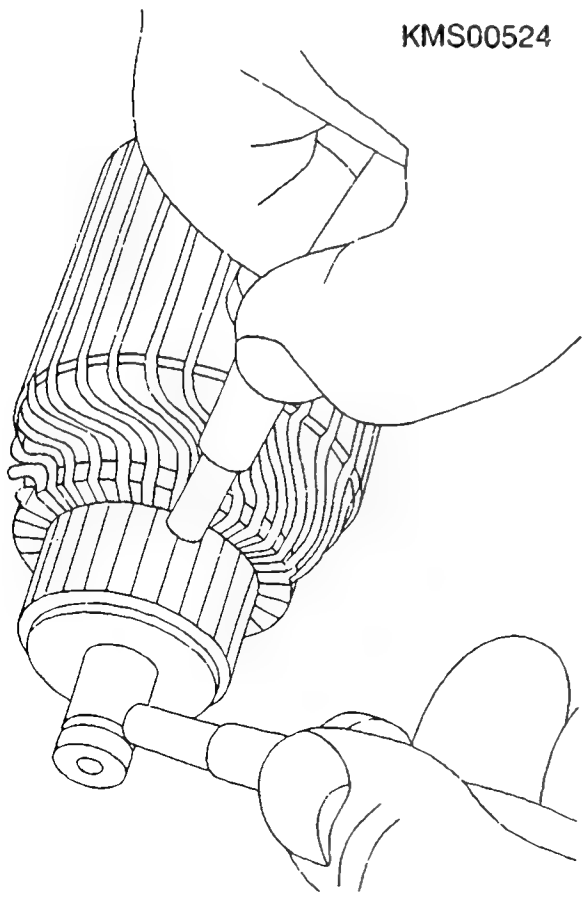
Checking armature

Use tester and test prods to check armature for short to ground and continuity (black laminations are an indication of an open circuit).

Interturn-short-circuit tester:	0 986 619 110
Test prods:	0 986 619 101
Test voltage for checking short to ground:	40 V*
Continuity test voltage:	40 V*

* = AC

Continue: II15/1 Fig.: III14/2



COMPONENT TESTING AND REPAIR

Testing commutator

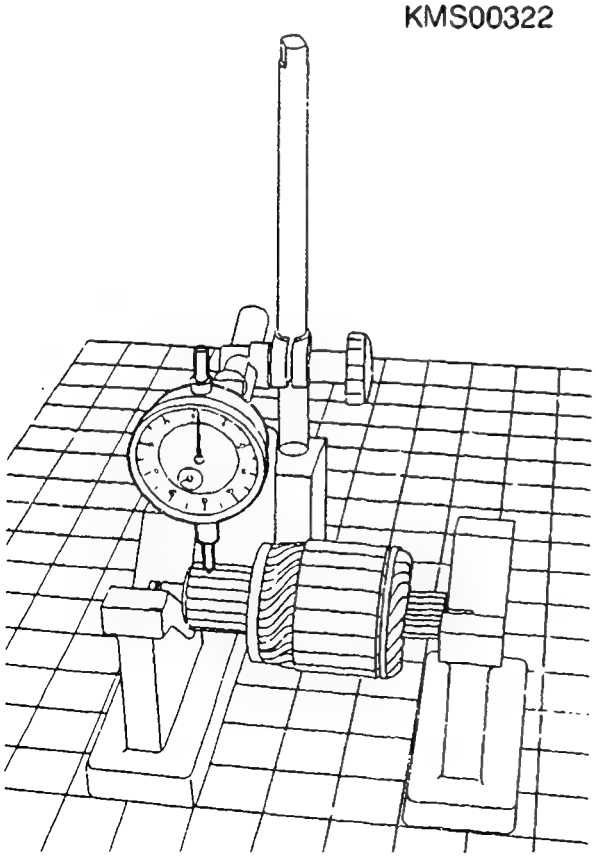
Check commutator concentricity.
If radial run-out is outside stated range, commutator must be turned down.

Magnetic measurement stand:	4 851 601 124
Dial indicator:	1 687 233 011

Radial run-out - Commutator:	< 0,01 mm

Continue: III16/1 Fig.: III15/2

KMS00322



COMPONENT TESTING AND REPAIR

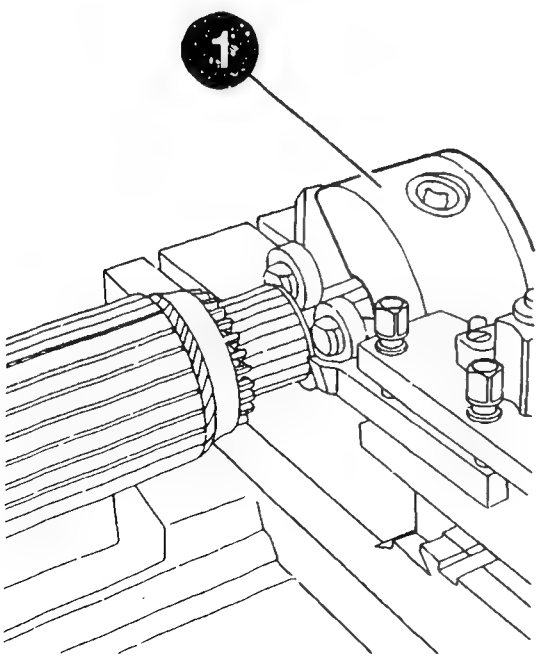
Testing commutator

Turning down involves positioning armature in three-jaw chuck and tailstock rest (1). The max. machining thickness is 0.03 mm.
Pay attention to minimum diameter.

Tailstock rest with Morse taper 2:	0 986 619 156
Mininum diameter:	31,2 mm

Continue: III17/1 Fig.: III16/2

KMS00193



Checking commutator

After turning down, the commutator segment insulation must be sawn out to a depth of 0.8 mm with a suitable tool.

After sawing out, turn down commutator again and check armature for interturn short circuit and short to ground. Pay attention to diameter.

The carbon-brush wear dimension is also to be checked with turned-down armature.

Continue: III17/2

The brush holder is to be replaced if necessary.

Interturn-short-circuit tester:	0 986 619 110
Minimum diameter:	31,2 mm
Test voltage when checking for short to ground:	40 V*

* = AC

Continue: II15/1

COMPONENT TESTING AND REPAIR

Checking carbon brush wear

The wear dimension must be checked with the armature fitted.

Clamp armature in clamping support.

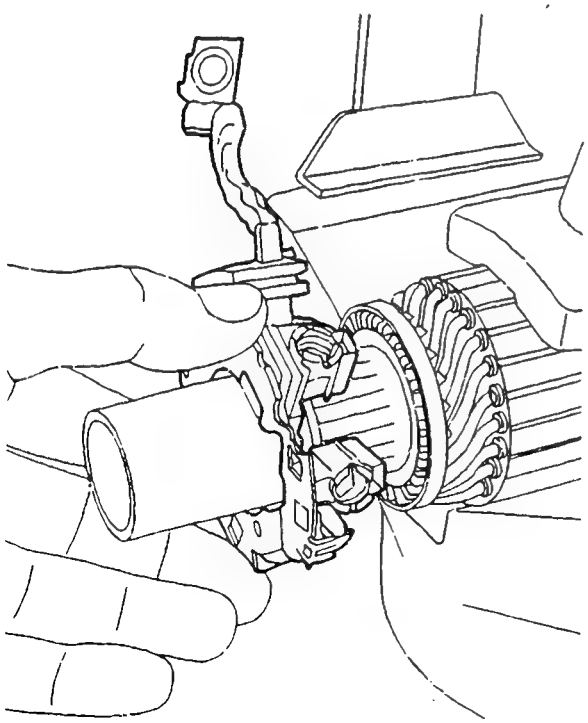
Pull brush holder with locating sleeve out of stator frame and slip onto armature shaft.

Slip brush holder from locating sleeve onto commutator.

Clamping support: 0 986 619 362

Continue: III19/1 Fig.: III18/2

KMS00423



COMPONENT TESTING AND REPAIR

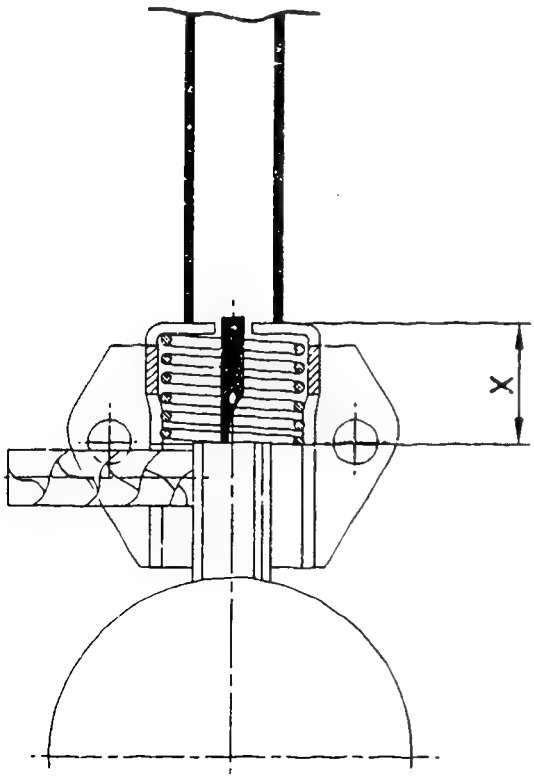
Checking carbon brush wear

The carbon-brush wear dimension x is measured with a depth gauge from the top edge of the cartridge-type brush holder to the top edge of the carbon brush.

Carbon-brush wear dimension x:	< 15 mm

Continue: III20/1 Fig.: III19/2

KMS00393



COMPONENT TESTING AND REPAIR

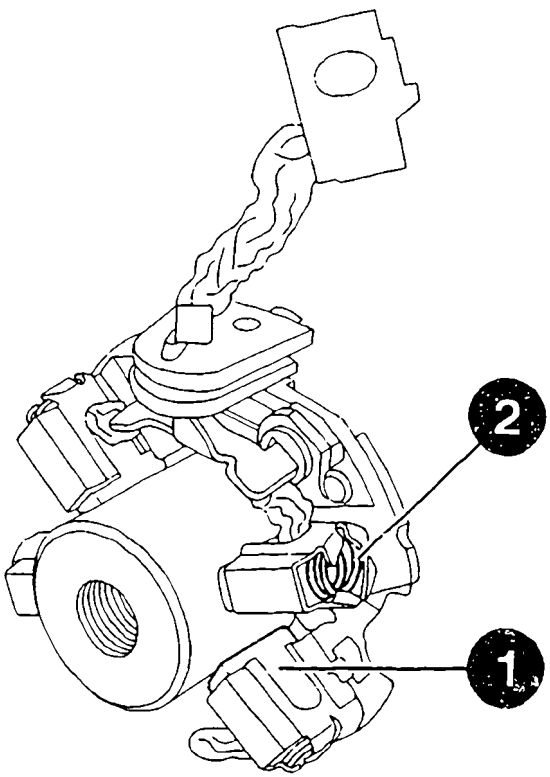
Checking carbon brush wear

The entire brush holder must be replaced if the carbon brushes (1) are worn down to the minimum length or damaged or if the helical compression springs (2) are worn.

Exclusive use is to be made of replacement parts from the list applying to the type of starting motor concerned.

Continue: III21/1 Fig.: III20/2

KMS00424



COMPONENT TESTING AND REPAIR

Checking carbon brush wear

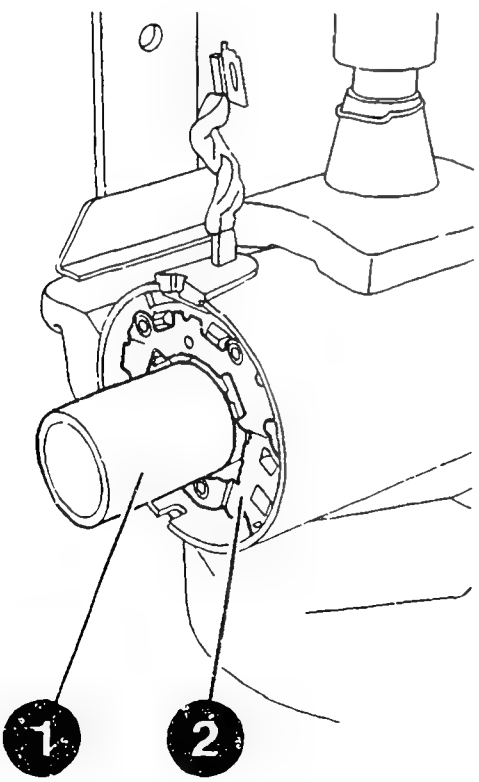
Brush holder installation:

Fit new brush holder in stator frame.
If old brush holder is re-used, slip it back onto locating sleeve (1) from commutator and insert in stator frame. Ensure correct positioning of locking element (2).

Brush holder locating sleeve:	0 986 618 134

Continue: II15/1 Fig.: III21/2

KMS00425



COMPONENT TESTING AND REPAIR

Checking stator frame

Check stator frame for damage.

Check permanent magnets for generating exciter field for damage and correct positioning in stator frame.

If necessary, the entire stator frame is to be replaced.

Continue: II15/2

COMPONENT TESTING AND REPAIR

Checking busbar
(if fitted)

Neither the busbar nor the thermo-plastic sheathing may be cracked or damaged in any other way.

If necessary, the busbar is to be replaced.

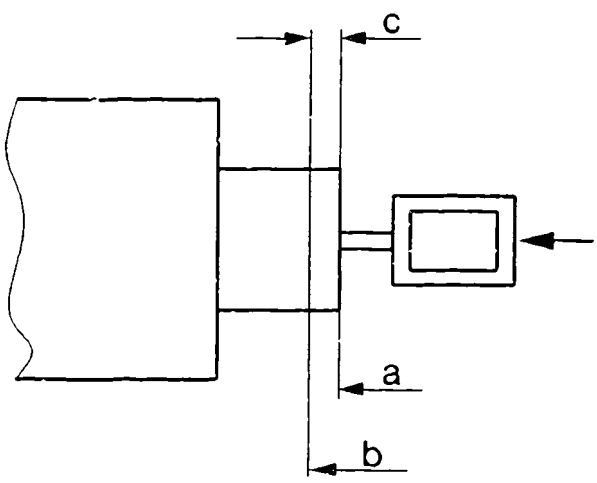
Continue: II15/2

Testing solenoid switch

Examine solenoid switch for damage.
Check burn-off reserve.
Press in armature by hand until current bridge is resting (a) on terminal stud. On pressing in the armature further as far as stop (b) a noticeable increase in force is apparent. The difference between positions (a) and (b) is the burn-off reserve (c). If there is no further burn-off reserve, the solenoid switch must be replaced.

Continue: III24/1 Fig.: III23/2

KMS00375



COMPONENT TESTING AND REPAIR

Checking solenoid switch

Use tester to check resistance of pull-in winding (term. 50/term. 45).

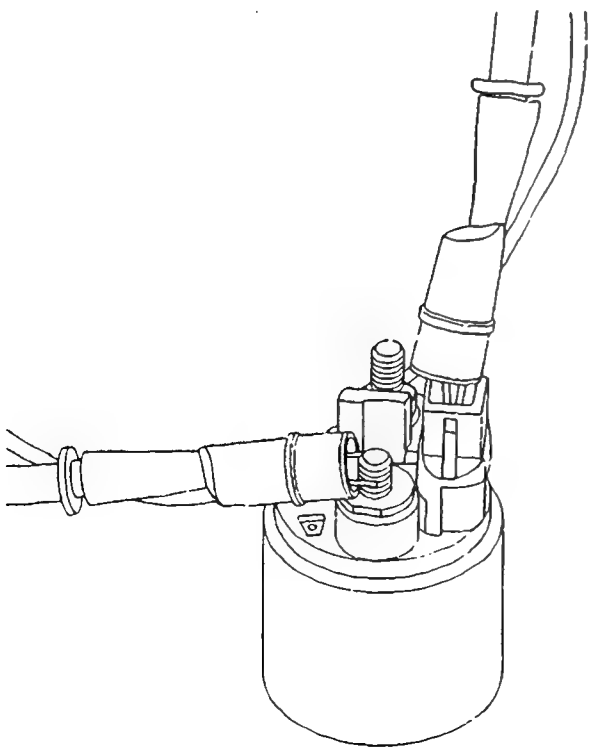
Alternator tester:	0 684 201 200

Resistance for starting motors

0 001 124 0..:	0,3...0,4 Ohm
0 001 125 0..:	0,3...0,4 Ohm
0 001 125 5..:	0,2...0,3 Ohm

Continue: III25/1 Fig.: III24/2

KMS00426



COMPONENT TESTING AND REPAIR

Checking solenoid switch

Use tester to check resistance of holding winding (term. 50/ground).

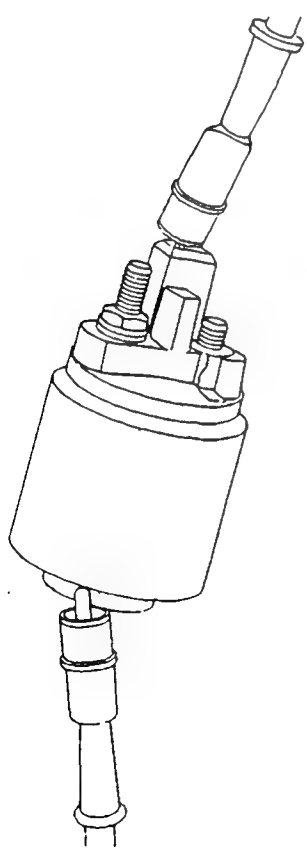
Alternator tester:	0 684 201 200

Resistance for starting motors

0 001 124 0..:	1,5...1,7 Ohm
0 001 125 0..:	1,5...1,7 Ohm
0 001 125 5..:	1,0...1,2 Ohm

Continue: III26/1 Fig.: III25/2

KMS00427



Testing solenoid switch

Neither the tests described, nor proper functioning of the solenoid switch when testing the function of the starting motor following repairs can provide reliable information on long-term trouble-free operation of the solenoid switch.
It is therefore advisable to renew the solenoid switch when the starting motor is repaired.

Continue: I01/1

STARTER ASSEMBLY TABLE

Continue: III27/2

STARTING MOTOR ASSEMBLY TABLE

Continue: I01/1

STARTING MOTOR ASSEMBLY

Assembling overrunning-clutch drive

Lubricate in line with lubrication schedule before and during starting-motor assembly.

During assembly of overrunning-clutch drive, cover of planetary gear train is to be secured to stop it falling.

Continue: III28/2

ASSEMBLING STARTER

Assembling overrunning clutch

Depending on starter version, the following assembly sleeve is required for overrunning clutch assembly:

Starter versions with bushing (pinion ID 13.5 mm): 0 986 619 415

Starter versions with needle bearing (pinion ID 14.7 mm): 0 986 619 406

Continue: IV01/1

STARTING MOTOR ASSEMBLY

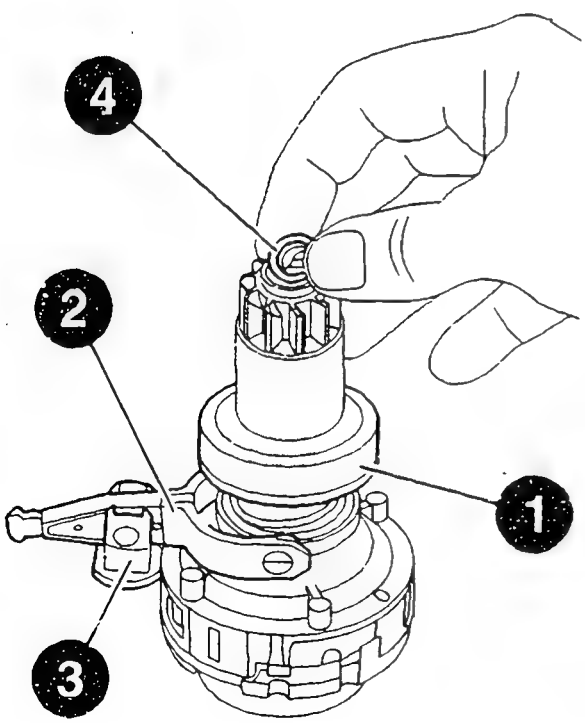
Assembling overrunning-clutch drive

Slip overrunning-clutch drive (1) with engaging lever (2) and mount (3), as well as new stop ring (4) onto output shaft.
ATTENTION: Spiral spline of drive must be dry and free from grease to stop the output shaft becoming pasty.
Only grease spiral spline on output shaft.

Grease VS 18036 Ft: 5 997 098 000

Continue: IV02/1 Fig.: IV01/2

KMS00428



STARTING MOTOR ASSEMBLY

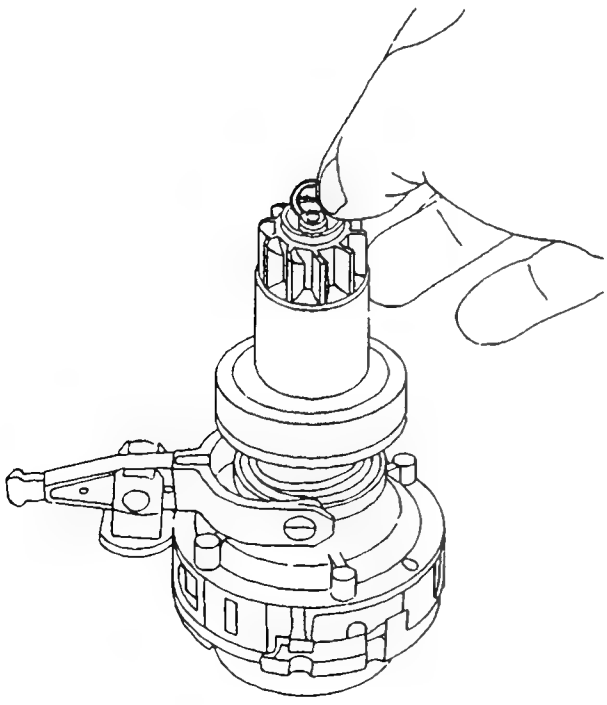
Assembling overrunning-clutch drive

Insert new snap ring in annular groove.

ATTENTION: Take care not to damage output shaft.

Continue: IV03/1 Fig.: IV02/2

KMS00429



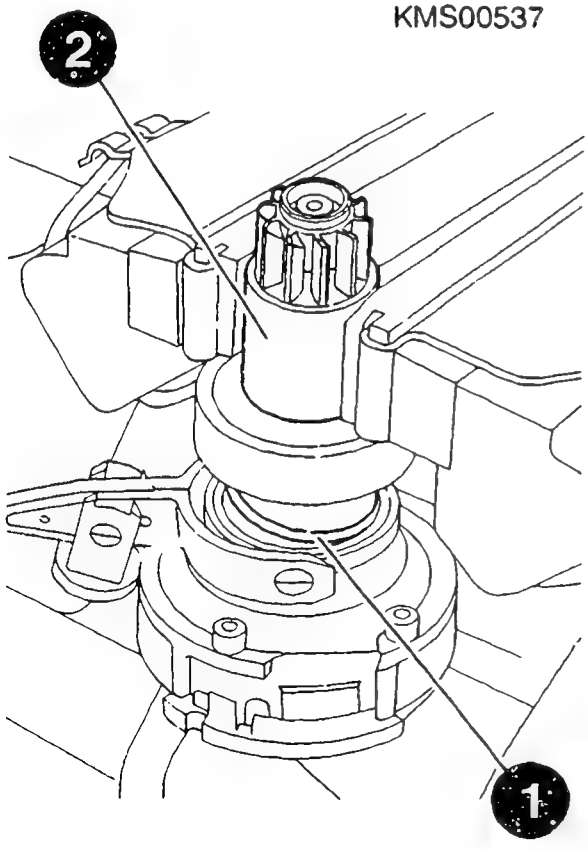
ASSEMBLING STARTER

Assembling overrunning clutch

Detach planetary gear (1) assembly from assembly stand and clamp between soft jaws in vice at pinion body (2).
ATTENTION: Take care not to damage surface of pinion body. Pinion body must not slip in vice during assembly. Assembly must not make contact with vice and must be free to move at the bottom.

Continue: IV04/1 Fig.: IV03/2

KMS00537



ASSEMBLING STARTER

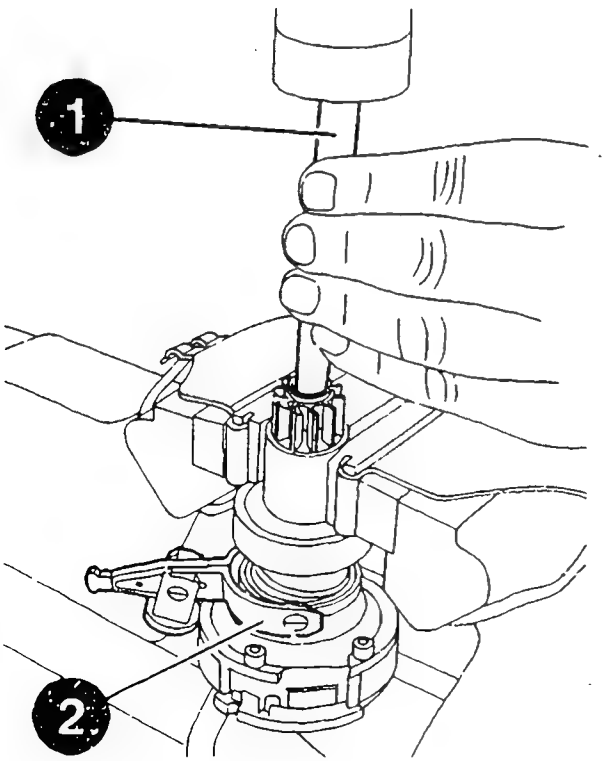
Assembling overrunning clutch

Position tapered end of assembly sleeve (1) on output shaft.
Tap firmly (plastic-headed hammer) on assembly sleeve to engage retainer beneath stop ring.
Detach assembly sleeve and position assembly (2) on assembly stand.

Assembly sleeve (depending on starter version):	0 986 619 415/406
Assembly stand:	0 986 617 138

Continue: III27/1 Fig.: IV04/2

KM-S00538



STARTING MOTOR ASSEMBLY

Assembling cap

NOTE ON PRESSING ON CAP:

Slowly increase pressure whilst pressing on cap and check firmness of cap several times.

Only exert sufficient pressure to ensure firm fit of cap.

Excessive pressure could destroy components.

Continue: IV05/2

ASSEMBLING STARTER

Assembling cap

When fitting collet chuck, make sure it is positioned correctly on cap. To do so, press collet slightly out of base when fitting.

Continue: IV06/1

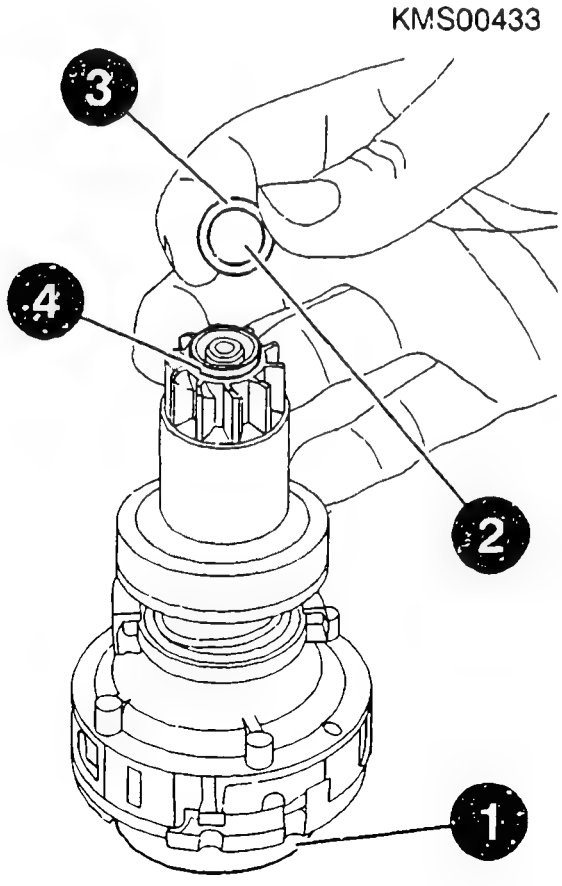
STARTING MOTOR ASSEMBLY

Assembling cap

Leave assembly on assembly stand (1) whilst assembling cap.

Position cap (2) with inserted sealing ring (3) on pinion collar (4).

Continue: IV07/1 Fig.: IV06/2



STARTING MOTOR ASSEMBLY

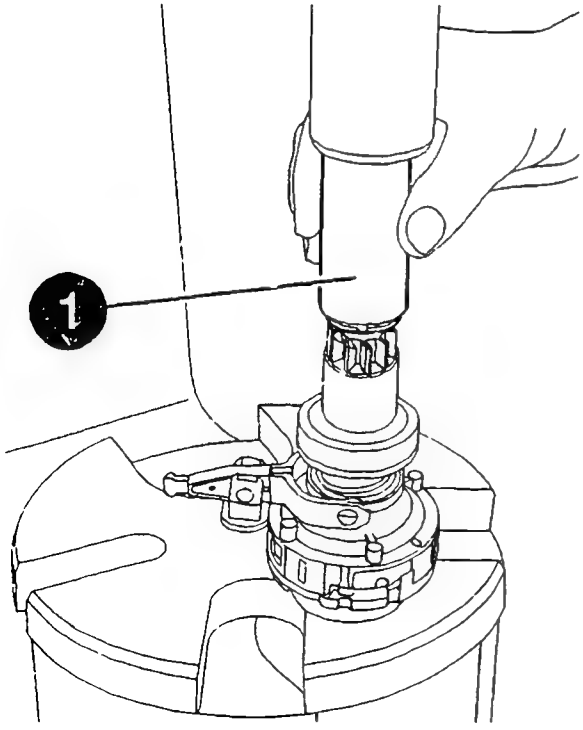
Assembling cap

ATTENTION: Always heed pressing-on instructions.
Fit collet chuck (1) and carefully press on cap using mandrel press.
Check firmness of cap several times.
Make sure collet chuck is correctly positioned. Release press, turn collet chuck through 45 and press on again.
Remove collet chuck and check correct positioning of cap.

Mandrel press:	comm. avail.
Collet chuck:	0 986 619 408/412

Continue: III27/1 Fig.: IV07/2

KMS00434



STARTING MOTOR ASSEMBLY

Assembling armature

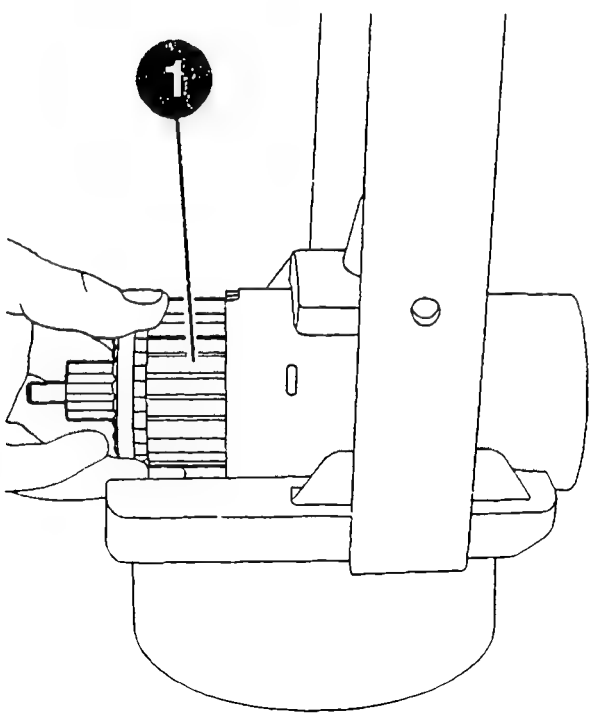
Clamp stator frame in clamping support. Insert armature (1) from drive-end bearing side into stator frame until armature shaft is positioned in hole of locating sleeve in brush holder.

ATTENTION: The armature is attracted by the stator frame due to the exciter magnetic field.

Clamping support: 0 986 619 362

Continue: IV09/1 Fig.: IV08/2

KMS00443



STARTING MOTOR ASSEMBLY

Assembling armature

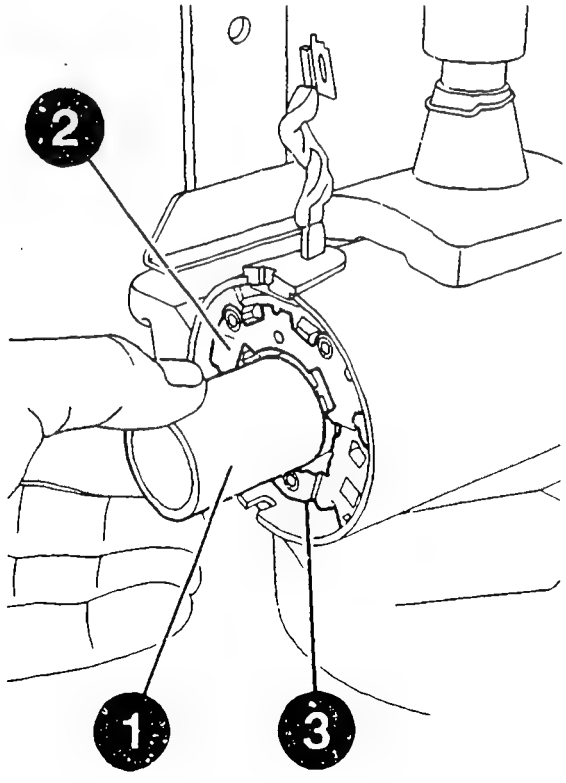
Push armature further in and at the same time pull locating sleeve (1) out of brush holder (2).

The carbon brushes must rest on the commutator.

Pay attention to correct positioning of locking element (3) in stator frame.

Continue: III27/1 Fig.: IV09/2

KMS00444



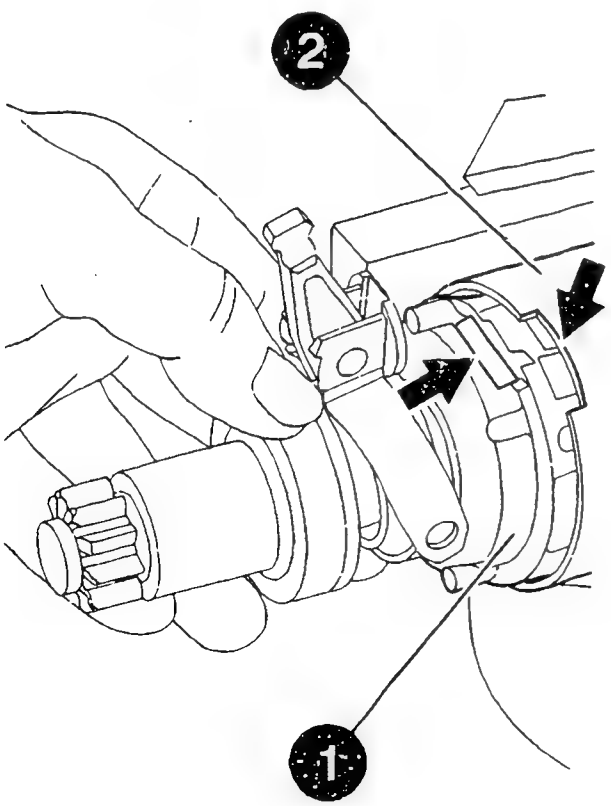
ASSEMBLING STARTER

Assembling overrunning clutch and planetary gear

Insert planetary gear (1) in stator housing (2).
Slight turning of planetary gear (1) facilitates meshing of sun gear in planet gears.
NOTE:
Position planetary gear such that recesses for rubber seal at stator housing and planetary gear (arrows) are in alignment.

Continue: III27/1 Fig.: IV10/2

KMS00519



ASSEMBLING STARTER

Assembling drive-end shield

Use three-square scraper to clean fitting surfaces at drive-end shield.

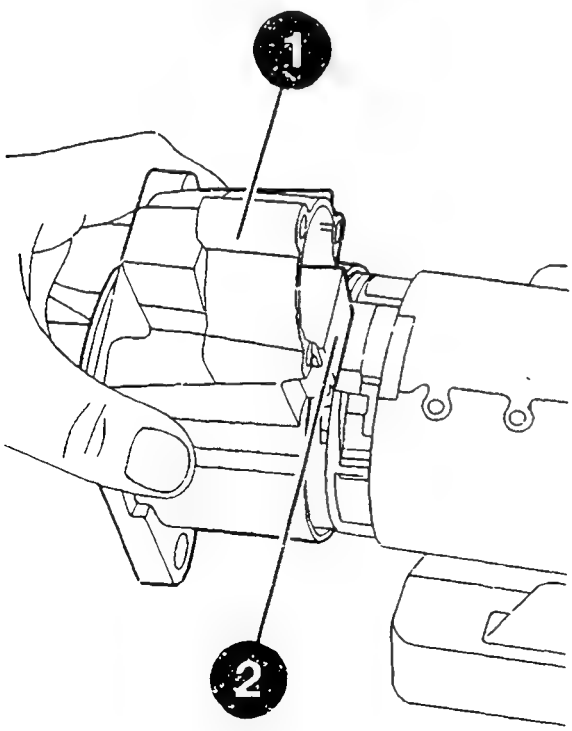
Slip drive-end shield (1) onto pinion body.
Position mount of engagement lever in drive-end shield (1) and insert rubber seal (2).

Pay attention to correct positioning of rubber seal (2) in stator housing and drive-end shield.

Three-square scraper: comm. avail.

Continue: III27/1 Fig.: IV11/2

KMS00520



STARTING MOTOR ASSEMBLY

Assembling commutator end shield

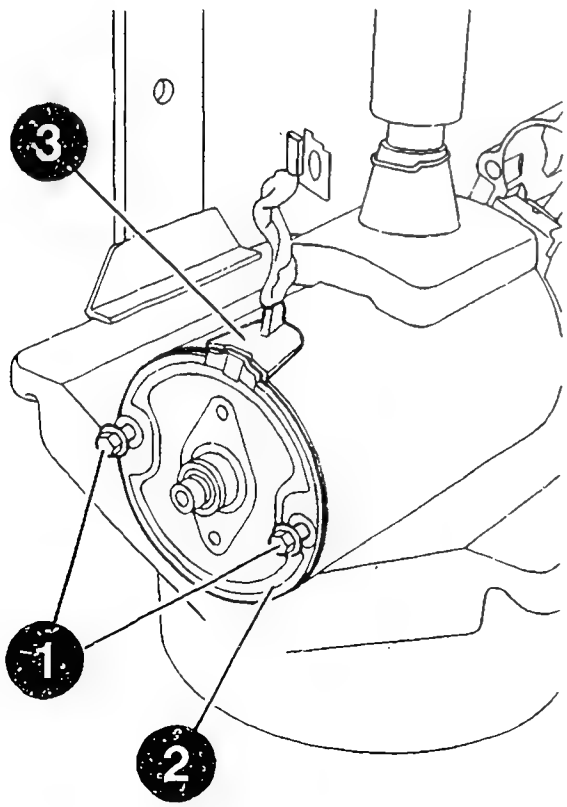
Position commutator end shield (2) on stator frame. Pay attention to correct positioning of end shield and gasket (3).

Slacken off clamping support, re-check positioning of drive-end bearing and secure bolts (1). Bolts must run in parallel with imaginary center axis of starting motor.
Use torque wrench.

Torque wrench:	comm. avail.
Tightening torque:	5,5...6,0 Nm

Continue: IV13/1 Fig.: IV12/2

KMS00400



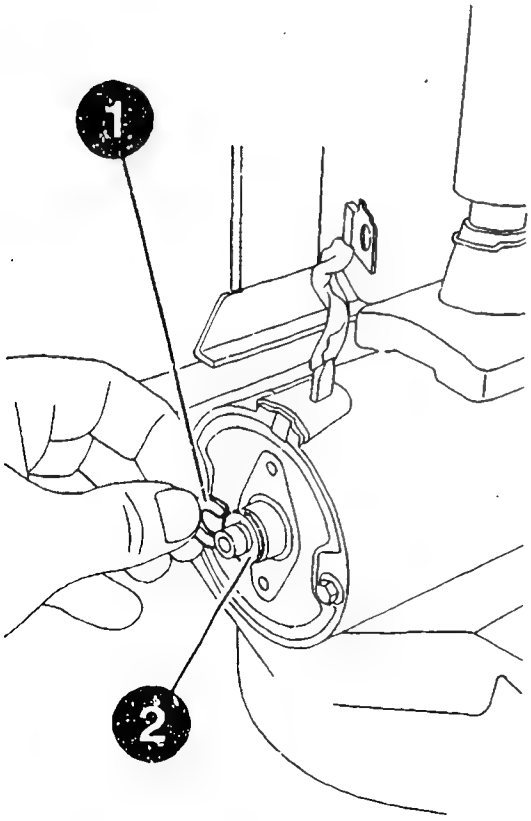
STARTING MOTOR ASSEMBLY

Assembling commutator end shield

Slip new shim (2) onto armature shaft and insert positioning washer (1) in annular groove.

Continue: III27/1 Fig.: IV13/2

KMS00399



STARTING MOTOR ASSEMBLY

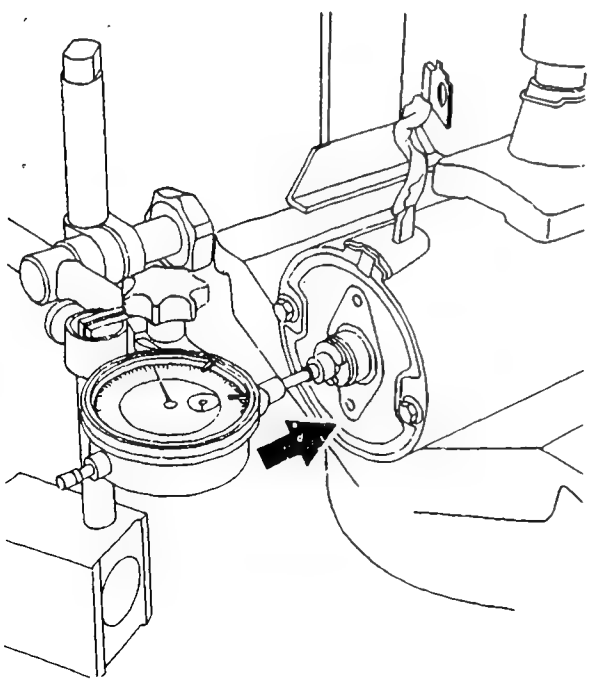
Checking and adjusting armature axial clearance

Push in armature as far as it will go in direction of drive-end bearing (arrow).

Apply dial gauge at end face of armature shaft and set it to "ZERO".

Continue: IV15/1 Fig.: IV14/2

KMS00447



STARTING MOTOR ASSEMBLY

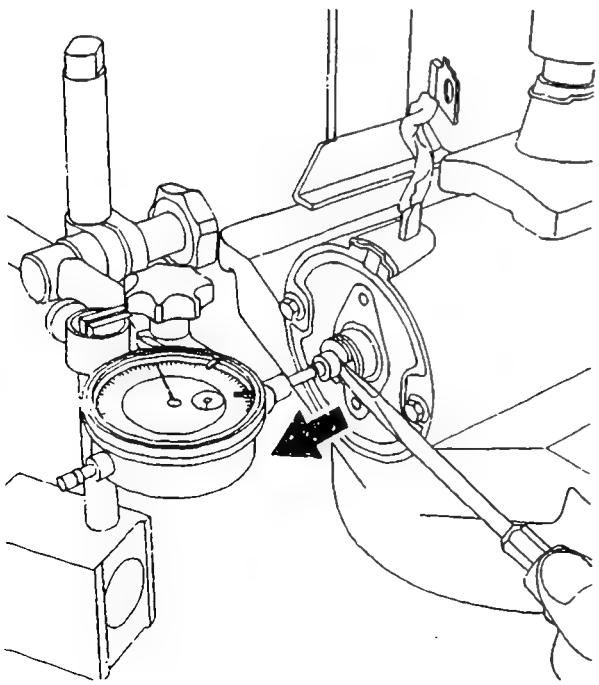
Checking and adjusting armature axial clearance

Move armature in direction of commutator end shield as far as it will go, read off armature axial clearance.
If armature axial clearance is outside stated range, adjustment must be made using an appropriate shim.
Then check armature axial clearance again.
Check freedom of movement of armature.

Armature axial clearance: 0,2...0,75 mm

Continue: III27/1 Fig.: IV15/2

KMS00448



STARTING MOTOR ASSEMBLY

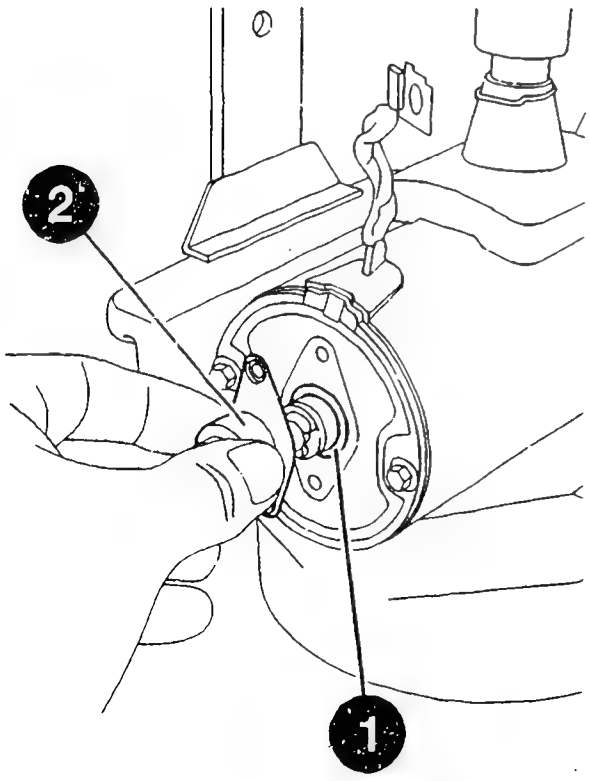
Assembling bearing end plate

Slip new gasket (1) onto commutator end shield.
Fill 1/3 of bearing end plate (2) with grease and secure.
Use torque wrench.

Torque wrench:	comm. avail.
Grease VS 18036 Ft:	5 997 098 000
Tightening torque:	1,5...2,0 Nm

Continue: III27/2 Fig.: IV16/2

KMS00449



STARTING MOTOR ASSEMBLY

Checking armature braking torque

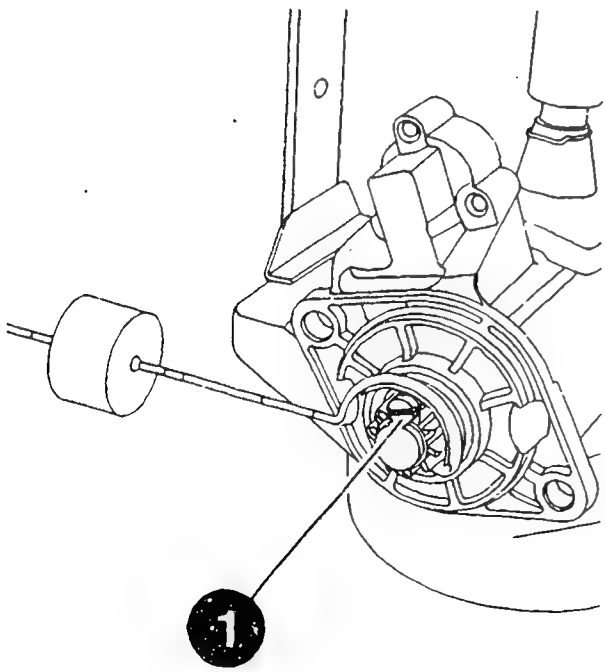
Insert bolt (1) or the like in pinion to guarantee correct positioning of torque meter.
Suspend torque meter from pinion in line with direction of operation of starting motor and move to horizontal position. Shift weight. Pinion may only start to turn as of mark "7".

Torque meter: 0 986 617 206

Armature braking torque: 0,7...1,2 Nm

Continue: IV18/1 Fig.: IV17/2

KMS00451



STARTING MOTOR ASSEMBLY

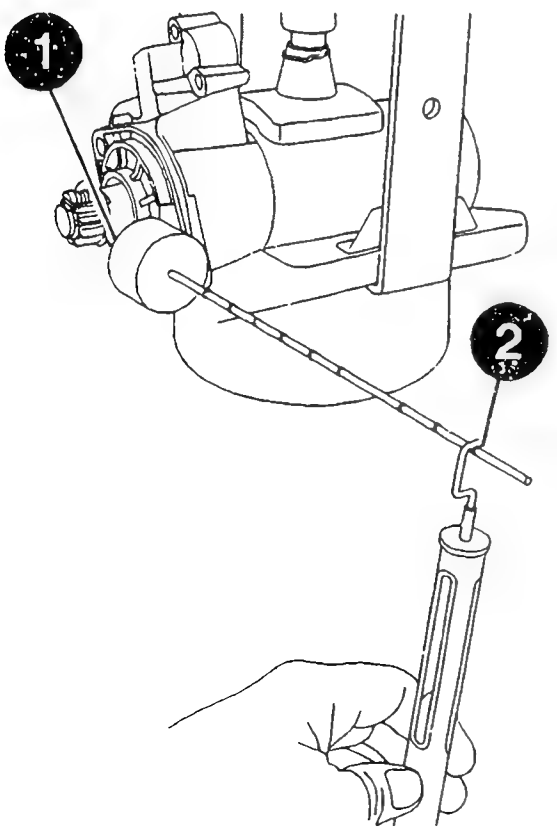
Checking armature braking torque

Proceed as follows if the torque applied with the torque meter is not sufficient to overcome the armature braking torque:
Move weight to second mark "2.0" (1).
Suspend spring balance at last mark "8" (2).

Spring balance: 0 986 619 181

Continue: IV19/1 Fig.: IV18/2

KMS00450



STARTING MOTOR ASSEMBLY

Checking armature braking torque

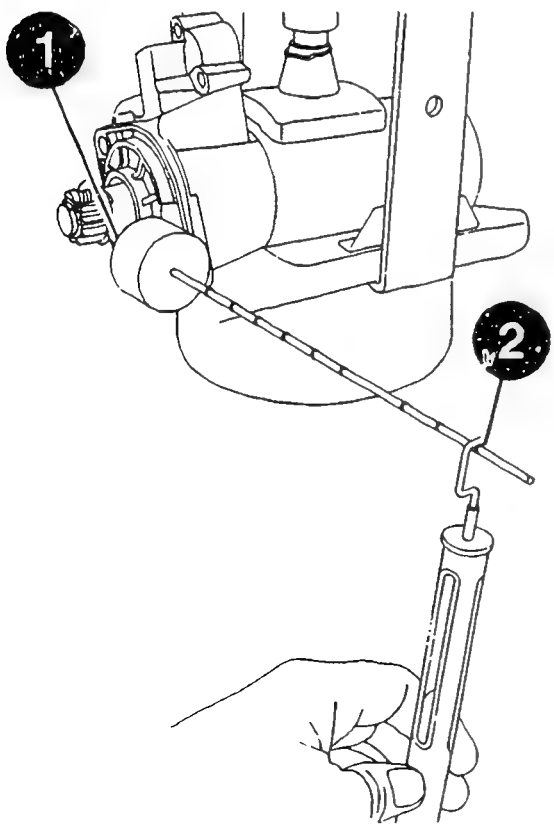
Pull on spring balance until pinion with armature starts to rotate. Take spring-balance scale reading. Reading must be between 0,21...0,35 kg, corresponding to a tensile force of 2,0...3,4 N.

The armature braking torque is then within the required range. Otherwise, check components and component assembly.

Armature braking torque: 0,7...1,2 Nm

Continue: III27/2 Fig.: IV19/2

KMS00450



STARTING MOTOR ASSEMBLY

Checking clutch overrunning torque

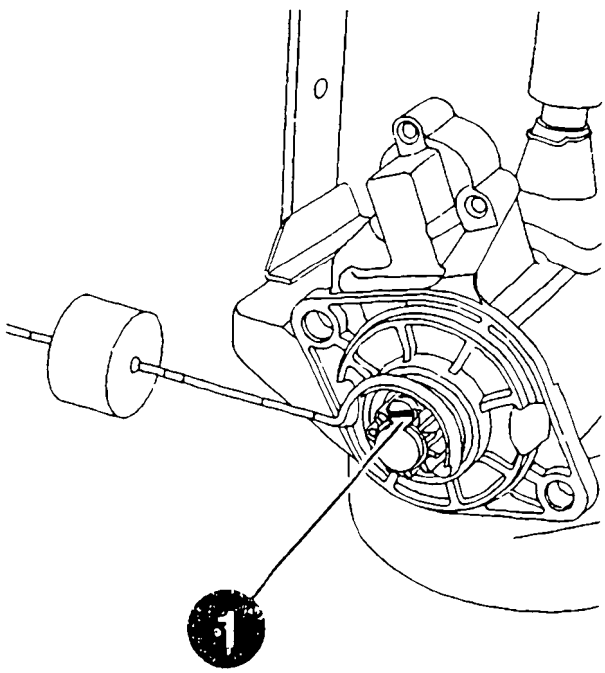
Insert bolt (1) or the like in pinion to guarantee proper attachment of torque meter.

Suspend torque meter from pinion in line with direction of operation of starting motor and move to horizontal position.

Torque meter: 0 986 617 206

Continue: IV21/1 Fig.: IV20/2

KMS00451



STARTING MOTOR ASSEMBLY

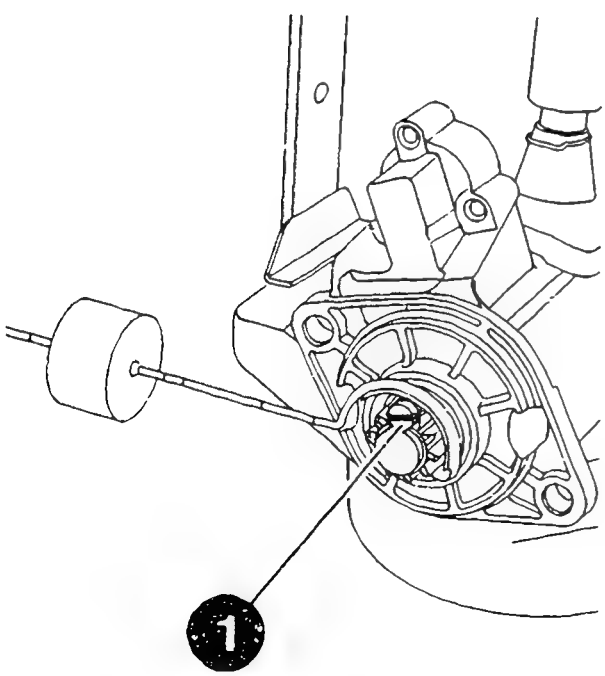
Checking clutch overrunning torque

Shift weight until pinion starts to rotate. The scale reading must be between "1,5"..."2,5", corresponding to an overrunning torque of 0,15...0,25 Nm.
ATTENTION: Torque meter must not make contact with drive-end bearing during test.

Clutch overrunning torque:	0,15...0,25 Nm

Continue: III27/2 Fig.: IV21/2

KMS00451



STARTING MOTOR ASSEMBLY

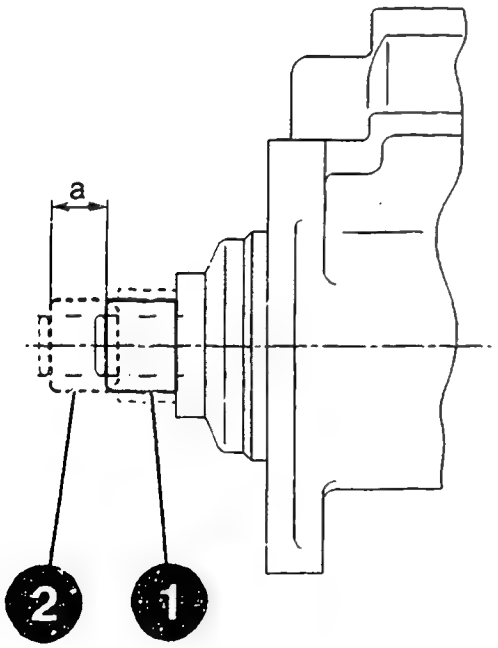
Checking total pinion travel

The total pinion travel is to be measured at the end face of the pinion between rest position (1) and end position (2) (fully meshed).

Vernier caliper:	comm. avail.
Total pinion travel a:	12...15 mm

Continue: III27/2 Fig.: IV22/2

KMS00452



STARTING MOTOR ASSEMBLY

Assembling solenoid switch

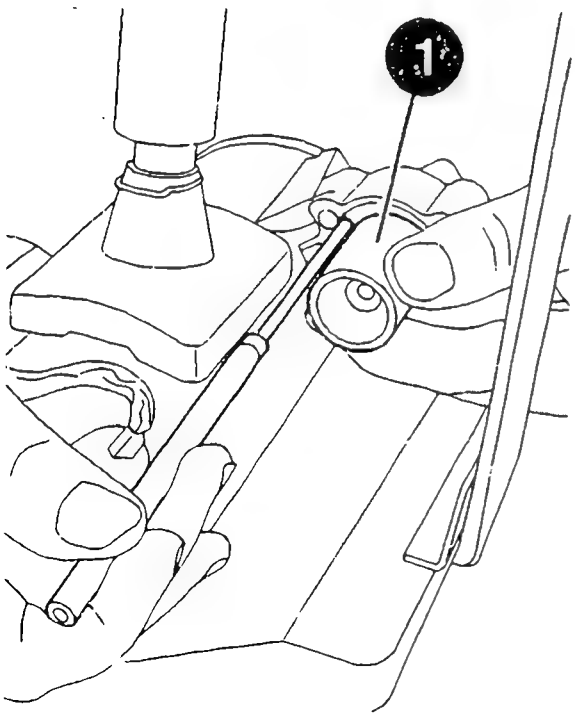
Use suitable tool to pull back engaging lever and engage solenoid switch armature (1) in engaging lever.

Apply small quantity of grease to periphery of switch armature. Pay attention to return spring in solenoid switch armature.

Grease VS 16634-Ft: 5 990 260 000

Continue: IV24/1 Fig.: IV23/2

KMS00397



STARTING MOTOR ASSEMBLY

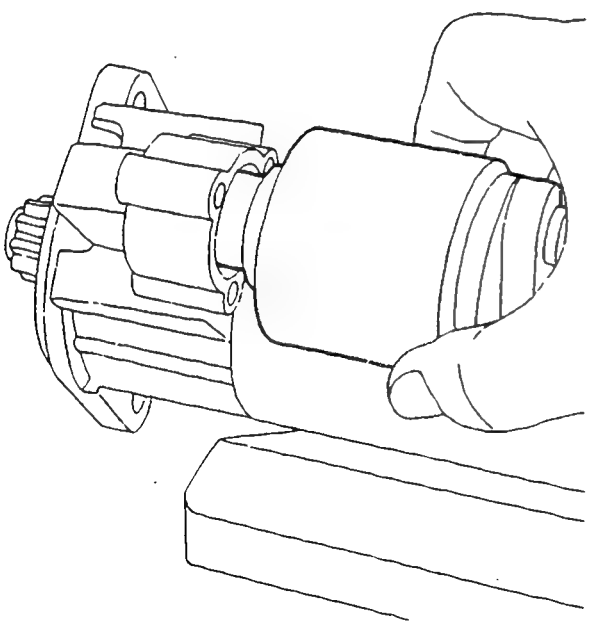
Assembling solenoid switch

Slip on solenoid switch and attach to drive-end bearing.
Make sure return spring is properly positioned in solenoid switch.
Pay attention to mark.
Use torque wrench.
Apply approx. 0.5 g of Loctite 577 (5 994 090 000) to threads of bolts.

Torque wrench:	comm. avail.
Tightening torque:	4,5...6,0 Nm

Continue: IV25/1 Fig.: IV24/2

KMS00396



STARTING MOTOR ASSEMBLY

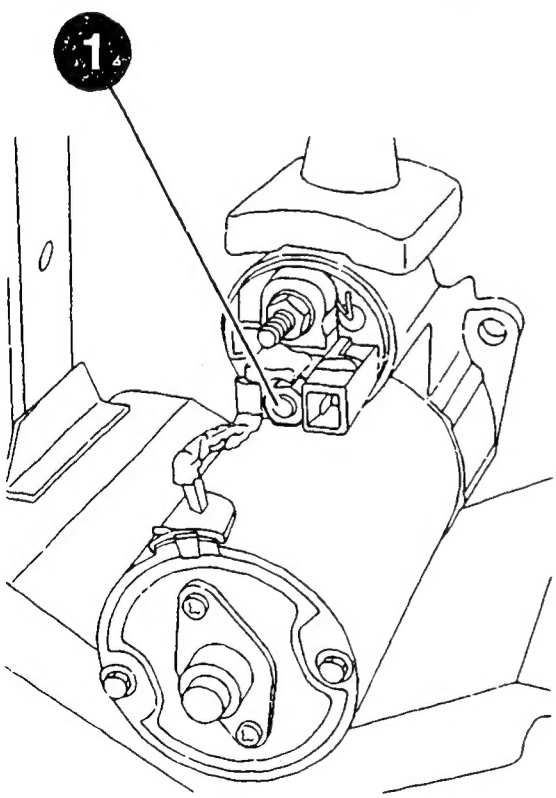
Assembling solenoid switch

Attach connection of brush holder (1) to solenoid switch, terminal 45. Use torque wrench.

Torque wrench:	comm. avail.
Tightening torque, term. 45:	7...9 Nm

Continue: IV26/1 Fig.: IV25/2

KMS00395



STARTING MOTOR ASSEMBLY

Assembling solenoid switch

Attach busbar (if fitted) to terminal 30 and drive-end bearing.
Use torque wrench.

Torque wrench:	comm. avail.
Tightening torque, term. 30:	7...9 Nm
Tightening torque for attachment to drive-end bearing:	5,5...6,0 Nm

Continue: III27/2

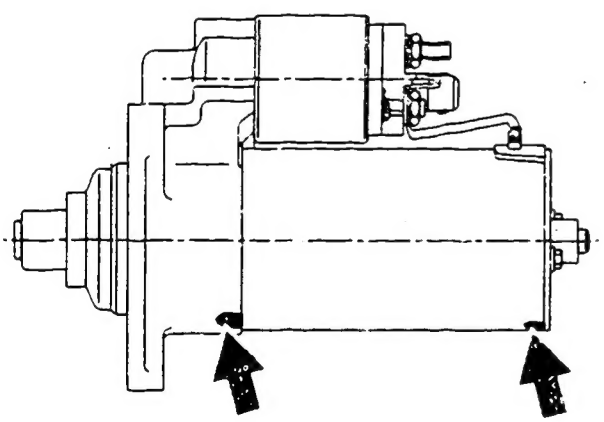
STARTING MOTOR ASSEMBLY

Painting starting motor
If starting motor is painted after assembly, make sure that paint does not ingress into the interior of the starting motor through the vent holes (see arrows) in the stator frame and drive-end bearing.

Seal off vent holes before painting. Always re-open vent holes after painting so as to ensure proper functioning of starting motor.

Continue: I01/1 Fig.: IV27/2

KMS00453



EDITORIAL NOTE

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Continue: IV28/2

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Continue: I01/1